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The Impact of Blockchain on Business Models

A study on how the attributes of blockchain affect the elements of Business Model

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Executive Summary

Technological antecedents can radically change the way firms organize value creation and engage in value exchange. Blockchain, considered to be an extension of internet is said to have the potential to disrupt many industries. Blockchain is an open, decentralised ledger for recording and moving information, value, assets between peers without the assistance of intermediaries. The transactions are done with in minutes and have minimal transaction fees.

Given blockchain's potential to disrupt many industries, it is important to investigate its implications on business models, which represent how firms create, deliver and capture value. Keeping this in view, the aim of this research is to study how the attributes of blockchain affect the elements of a business model. In order to see the impact of these attributes on individual elements of a business model, a framework was developed based on the works of Teece (2010), Zott and Amir (2010), Ostwalder & Pignuer (2010) and Weill & Woerner (2013).

Using Delphi Technique methodology, the impact of the attributes of blockchain on the elements of business model was assessed. From the results of the study, it was inferred that blockchain has the potential to facilitate significant innovation in business model. However, it should be kept in mind that the results would be most applicable to firms who rely on intermediaries for recording and exchanging information, value, assets. The more the reliance on such intermediaries, the greater the expected benefits of using blockchain to innovate business model. Whereas, intermediaries who provide services with regards to recording and exchanging information, value or assets face great risk from blockchain, and thus should look to either incorporate blockchain in their business models or find other means to counter the threat.

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1. INTRODUCTION

Technological disruption is considered not only a trigger for business growth but in some cases it may even result in drastics industrial shifts through the introduction of new & better products (Kostoff et al., 2004). Historically, technological antecedents have provided companies opportunities to change the fundamentals of how they organize value creation and engage in value exchange, both inside and outside the firm and industry boundaries (Mendelson, 2000). In essence technology can facilitate new business models (Baden-Fuller & Haefliger, 2013).

An example would be the recent advances in information and communication technologies such as the Internet and the rapid decline in computing cost, which provided new ways to create and deliver value (Zott et al., 2011). The world wide web not only gave rise to new types of business model such as e-commerce, but also allowed companies to better their value creation and exchange mechanism by providing benefits such as disintermediation, lower costs, access to markets, and global commerce. Many entrants such as Amazon moved in the market with internet enabled business models and traditional brick-and-mortar incumbents such as Barnes and Noble had to drastically adapt their value creation logic to remain competitive. Business models can thus be a source of competitive advantage (Ranjith, 2016).

The benefits of internet technologies have lowered the barriers to market entry and made competitive advantage difficult to sustain. This is why businesses must constantly evaluate what customers value most and create operating models that take advantage of what's newly possible by utilizing the right technology. One such technology that is being eyed by businesses as an extension of internet, and considered to have the potential to cause business disruption is the blockchain (Tapscott & Tapscott, 2016). Blockchain, "[…] the technology underlying bitcoin and other cryptocurrencies—is a shared digital ledger, or a continually updated list of all transactions" (Morrison, 2016). "Blockchain enables people to exchange value or information safely from one person to another, without going through a central authority of trust such as government, bank, a credit card company, or PayPal" (Tapscott & Tapscott, 2016, p.6). It is due to this characteristic that it is sometimes referred to as the "internet of value or money" (Tapscott & Tapscott, 2016). This particular novelty and usefulness of the technology has motivated us to explore how it may affect the business

model of companies. This would not only add value to academic literature but will also have practical insights for the business sector.

1.1 Addressing the Gaps in the Literature

Technological developments can introduce benefits such as cost saving, efficient processes or access to new markets, which give firms reasons to change their way of doing businesses. Chesbrough (2010) has suggested that companies can capture the latent economic value of a technology by commercialising it in some way via a business model . In other words, business model is linked to economic outcomes. From this we understand that it is important for companies to do business model innovation (BMI) by incorporating relevant technologies in order to stay competitive or risk being driven out of the market. There have been several examples of this such as the demise of Eastman Kodak and Polaroid corp. due to the emergence of digital photography whereas companies such as Apple that used technology to build unique business models saw great market success.

Given that blockchain technology has the potential to significantly disrupt traditional industries (Ølnes et al., 2017), it becomes imperative to understand its effect in extant business models. While, existing literature has discussed technological advances as a main driver of business model innovation (Foss & Saebi, 2017; Saebi et al., 2017), it is not clear how exactly the emergence of a new technology, such as blockchain, can lead to the formation of new business models. Arguably, a reason for this lack of research lies in the ambiguity of defining what exactly blockchain technology entails and what exactly defines a business model. We summarize the most pressing research gaps below

- We noted that studies that explore the effect of new technologies on the elements of business models are not prevalent in academic literature.
- The majority of existing research related to blockchain has been focused on Bitcoin, (Yli-Huumo et al., 2016). Research needs to reach beyond this narrow focus in order to understand the full effect of blockchain technology on firms' business models.
- There are only a limited number of peer-reviewed, academic studies on this topic. Currently most of the research has been presented in conferences and workshops (Yli-Huumo et al., 2016). Hence, there is a need for well-grounded, scholarly inquiry into the business implications of Blockchain.

1.2 Research Objective and Questions

As stated earlier, a new technology can act as an important antecedent for business model innovation (Foss & Saebi, 2017) which happens when two or more elements of a business model are reinvented to deliver value in a new way (Lindgardt et al, 2009). It is also suggested that "business model innovation can range from incremental changes in individual components of business models, … right through to disruption of the business model, which may potentially entail replacing the existing model with a fundamentally different one" (Khanagha et al., 2014). Based on this, we have a case for research to determine if any business model innovation is possible via blockchain by seeing how the attributes of blockchain may impact the elements of business model. From this argument and gaps identified above, the objective of our research is presented below

To add value to the academic literature and provide organizations' insights on the potential impact of the attributes of blockchain on the elements of business model

Following the objective, the research question is formulated as below:

How do the attributes associated with blockchain affect the individual elements of a business model ?

In order to answer the main research question, the following sub-questions have been developed:

R1. What is blockchain and its attributes?

It is important to understand the nature of the technology to see how it relates to the context of an organization or industry. Attributes of blockchain will highlight what it offers and would be used later to gauge the impact of technology on the elements of business model.

R2. What are the elements of a business model?

Since there are divergent views on the topic of business model, this question delves into different perspectives available in literature in order to understand the concept and elements of business model in order to develop a framework.

R3. How does blockchain affect the elements of business model?

This question will be answered using Delphi technique, a structured communication method that relies on a panel of experts, to gain insights into the potential implications of blockchain on businesses. The results will be used to determine which attributes of the technology can impact the elements of business models.

1.3 Scope of the thesis

We are exploring the issue of how blockchain may impact business models from the perspective of incumbents in general, who may potentially use blockchain to innovate existing business models. We could have approached the thesis from the perspective of entrants or companies that develop blockchain, provide infrastructure and resources related to the technology, however due to time limitations, it would have been difficult to address the issue in such breadth. This does not however, mean that such businesses cannot gain insights from our work as they can still use the findings to see which areas of the businesses are affected by blockchain to better position their solutions. In our literature review, we have had a relatively selective approach and tried to include the most relevant works in the field so far. Therefore, our selection of literature is not completely exhaustive, especially considering that the literature in the field is growing.

1.4 Thesis structure

Our thesis is comprised of nine chapters. Chapter 1, introduces our paper, its objective and research question. Chapter 2, is a literature review on the topic of blockchain and business model. The review of business model literature is done to develop a business model framework based on existing knowledge. Chapter 3, explains the research methodology. Chapter 4, consists of the research analysis and findings. In chapter 5, we make inferences from the findings to answer the research question. Chapter 6, states the implications of research for both academia and practise. Chapter 7, presents the limitations of research. Chapter 8, states the possibilities for future research. The last chapter 9, provides the concluding remarks of the study.

2. LITERATURE REVIEW

In order to answer research questions R1 and R2 we will first present an overview of blockchain and the attributes associated with it. We will then discuss the concept of business model and use selected literature to develop our own framework. The identified attributes of blockchain and the elements of the proposed framework will form the basis of our research and analysis later in the thesis.

2.1 Blockchain as a Disruptive Technology

Throughout the course of humanity, technology has had a huge influence on improving the quality of life, global economies and business growth. When it comes to organizations, Christensen (1997), a leading researcher on business models, highlights two different types of technology that affect business; sustaining technologies and disruptive technologies. Sustaining technology allows organisations to make gradual improvements in products while industry status quo is maintained. Disruptive technologies, are breakthroughs that can challenge the existence of companies. They don't generate interest in the beginning but with time they completely replace existing products. Good examples would be mobile phone, digital photography and online. There are the two characteristic that can help identify a disruptive technology. One, they develop and gain interest over a period of time. However, once they start getting acceptance, their adoption is fast, resulting in replacement of established systems. The second characteristic is that disruptive technologies rarely come from established organisations, as they are not initially seen to have great potential.

Blockchain satisfies these two characteristics of being a disruptive technology. It has been around since 2008, however only recently it has been catching the attention of businesses. It is the technology that is the backbone of bitcoin. It was created by an anonymous person or group of people under the pseudonym Satoshi Nakamoto in 2008. Bitcoin not only introduced the world to cryptocurrencies, but also introduced blockchain which is a distributed ledger (Nakamoto, 2008). It is a decentralised network for storing and exchanging information or value over the internet (Mougayar, 2016). Therefore, it is important to see the business implications of this technology as it can potentially cause drastic industry shifts by facilitating new and better ways of doing business.

2.1.1 The Limitations of the Internet and the Emergence of Blockchain

By offering services such as e-mail, the World Wide Web, dot-coms, social media, the mobile Web, big data, cloud computing, the internet has benefitted societies at large by reducing the costs of searching, collaborating, and exchanging information. It has also brought new business models of media and entertainment, retailing, socializing, and other digital ventures. Even though the Internet has enabled many positive changes, it still has serious limitations for business and economic activity. On the internet, there is no mechanism to reliably establish identities or trust in order to conduct transactions without the validations of third parties such as banks. Then there is the issue of data privacy, as in the past organizations have invaded consumer data entrusted with them for commercial gains or national security. Centralised database breaches have also increased in the recent past and even the most expensive security systems have failed in the face of such online hacks. Further, the internet still excludes about 2.5 billion people from the global financial system (Tapscott & Tapscott, 2016).

However in 2008, one potential solution to address the above problems was created by Satoshi Nakamoto in the form of blockchain technology along with its first application Bitcoin. Just as we saw that the web replaced some intermediaries, blockchain has the potential to replace even more intermediaries, while at the same time creating new ones. Mougayar (2016) suggest that current companies who act as intermediaries in the value chain will need to figure out how their roles will be affected as entrants are moving to take a piece of the market through blockchain.

2.1.2 The Blockchain Concept: How it Works

Blockchain is the foundational protocol on which many decentralised applications can be run. Business wise, it is a global ledger for recording and moving information, value, assets between peers without the assistance of intermediaries. The transactions are done within minutes and have minimal transaction fees. The blockchain validates transactions between parties, thus replacing previously trusted entities who performed this function. Technically, the blockchain is a back-end database that maintains a distributed ledger which is open source (Mougayar, 2016). It is an encrypted, distributed database shared across multiple

computers or nodes that are part of a community or system (Iyer, 2016). Blockchain processes a transaction through a decentralised networks of computers (nodes) connected to each other via internet. Below is a synthesised and simple version of how a transaction is processed on blockchain
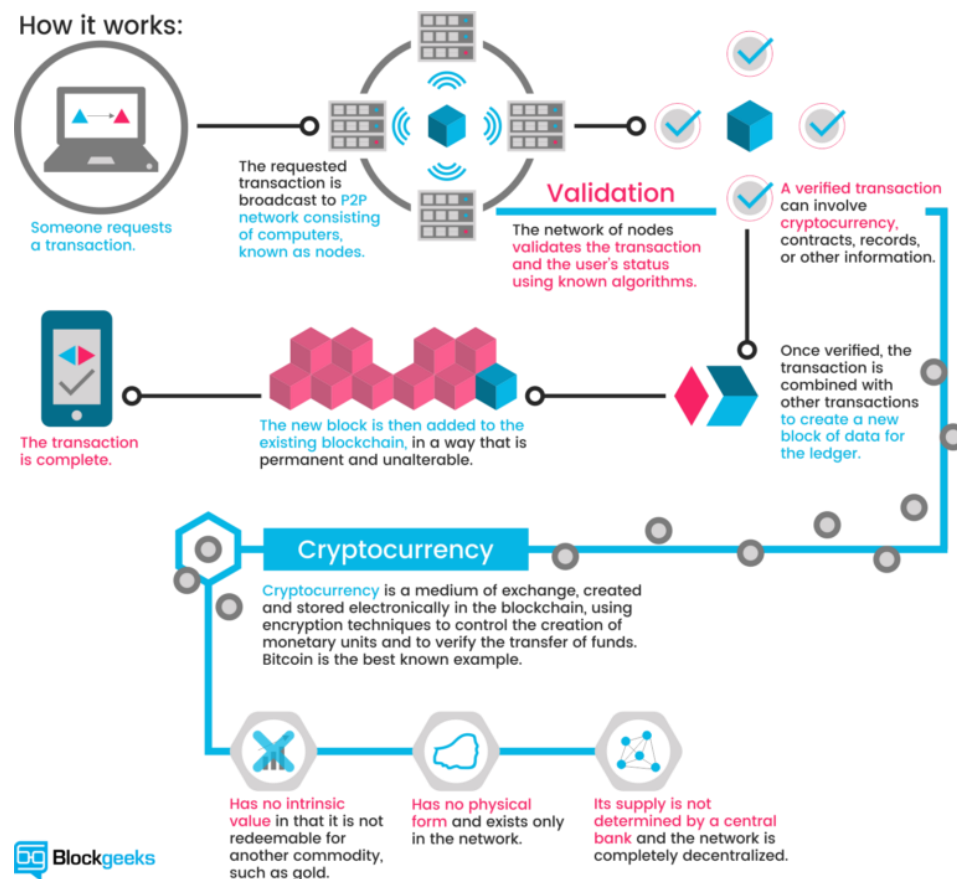
Figure 1 (De Castro, 2016)

(1) The user creates a transaction that can contain any kind of information or value. The transaction can be of money or any information such as documents, data or contracts. The transaction is created through a user application running on a device that is connected to the internet.

(2) The user digitally signs the transaction using cryptography so that the origin and authenticity of the transaction can be verified

(3) The application broadcasts the transaction into a peer to peer network of computing devices, known as nodes.

(4) When the nodes in the network receive the transaction, it's authenticity is verified using cryptography and algorithms

(5) Once verified, the transaction is time stamped with a unique ID so that transaction history can be traced. It is then combined combined with other verified transactions in the network to create a block of data

(6) The new block is then added to existing chain of blocks using cryptography, making it permanent and immutable. The bigger the blockchain grows, the more immutable it becomes, because to change stored records, an individual will have to change the data on every previous block.

In sum, blockchain is a ledger of transactions which is distributed across a network of nodes (Swan, 2015). This means every node on the network has the same copy of the ledger. The cryptographic process that nodes use to link a new block to existing chain is called mining. Miners do this by assigning computing resources for this process. This 'proof-of-work' approach makes sure that participation in the process of mining is not free and therefore achieving majority control of the network would be extremely costly if not impossible (Tapscott & Tapscott, 2016).

Similar to the internet, blockchains also have public and private versions . A public blockchain is a ledger that anyone can read, can send transactions to, expect to have them added to the ledger if they are valid, and can participate in the *consensus process* – the process for determining which blocks get added to the chain and what the current state of ledger is. Due to these characteristics these blockchains are considered fully decentralized. A private blockchain is a ledger where consensus permissions are restricted to specific users. Read permissions may be public or restricted depending on requirements (Jayachandran, 2017)

2.1.3 Blockchain based Decentralised Apps and Smart Contracts

Because the Blockchain space is in development, there are many protocols and standards that are emerging. Two such important concepts are; Smart Contracts and decentralized apps. It is important to understand these concept as they help us better understand the attributes of the technology, discussed later in the literature review.

Dapps

Dapps run on top of blockchain and serve some particular purpose to its users (Tapscott & Tapscott, 2016). In our opinion, these applications will embody some or all attributes of blockchain that may translate into business benefits for companies who are looking to employ blockchain in their businesses.

We would like to mention that one of the most prominent platforms to build DApps is Ethereum. It makes the process of creating and deploying decentralised applications on blockchain much simpler and efficient. Ethereum also provides the capability to insert smart contract functionality into a DApp if needed (Swan, 2015). This means, instead of having to build an entirely original blockchain for each new application, companies can instead use the Ethereum platform to develop and deploy applications suited to their needs.

Smart contract

Smart contract is a tool to program and automate any type contract or agreement. Through code, contractual conditions of a transaction are defined on blockchain. Once those conditions have been met, the transaction is automatically executed through code (Swan, 2015). This has big consequences for business as they can, for example, avoid the paperwork, time delays and costs associated with initiating and executing contracts and make their business processes much faster, leading to efficiency

2.1.4 Attributes of Blockchain

In this section we discuss the attributes of blockchain and then highlight their business implications in various industries. These attributes have been taken from the book 'The Business Blockchain' by Mougayar (2016). Though Mougayar (2016) outlines these attributes, not all are explained in detail. Hence, we studied a variety of books and papers in an attempt to provide description for the selected attributes. In our opinion this is necessary because attributes reveal what a technology has to offer and in turn how it may affect a business. The key attributes of blockchain are discussed below

Privacy

There have been growing concerns regarding businesses that collect and control personal data as there has been a recent the rise in incidents related to surveillance and breaches compromising user privacy. Due to its decentralised nature, blockchain reduces the possibility of privacy breaches . In a blockchain network, there is no central authority that can control or manipulate data. In a blockchain network, data is not stored in a file at a central server; but is recorded in the form of transaction on a distributed ledger. Every data recorded on blockchain is heavily encrypted to maintain virtual privacy (Tapscott & Tapscott, 2016).

Also the data is under user's control (Zyskind and Nathan, 2015), which entails that people and not certain institutions receive compensation for any use of data that has value to another party. We argue that due to this, there is a possibility for firms to offer better data privacy and control options to its customers, which may enhance the value of a company's products in consumer minds. The privacy aspect may become more important in situations where regulatory authorities and customers demand companies to ensure privacy of data and not trade user information.

Lower fraud risk

Blockchain is attributed to have immutable structure, which means altering its content is almost impossible. Data is stored on ledger, a copy of which is hosted across the numerous nodes. With blockchain, there is no single database to tamper with (Cai and Zhu, 2016; Swan, 2015). This feature may allow companies to reduce frauds as it is nearly impossible to change records on blockchains and thereby reduce business risks.

Transparency

The blockchain ledger can be programmed to record virtually any type of information as long as it can be expressed in code. This could include birth and death certificates, marriage licenses, deeds and titles of ownership, educational degrees, financial accounts, medical procedures, insurance claims or votes (Tapscott & Tapscott, 2016). Blockchain leads to transparency between firms and stakeholders as data auditability becomes possible (Atzori, 2015; Palfreyman, 2015; Tapscott and Tapscott, 2016). This interoperability of data across firms can allow for more timely decisions and collaboration. This will be particularly

relevant to industries in which real time data sharing is important but difficult to achieve due to fragmented systems or lack of integrations.

Security

The security of individuals and companies are at risk over the internet due to incessant attempts of hacking, identity theft, fraud, cyber bullying, phishing, spam, malware, ransomware (Tapscott and Tapscott, 2016). Cyber security is therefore very important but becoming difficult to sustain as cyber attacks are becoming increasingly sophisticated. Courtot (2016) cites cyber-crime as one of the biggest risks businesses are facing today. Because blockchain is encrypted and decentralised, it reduces the chances of cyber theft and data corruption as hacking multiple databases at the same time is quite difficult (Gervais et al., 2016; Mainelli and Smith, 2015; Tapscott and Tapscott, 2016). There is no single point of failure in blockchain and the network does not have centralized servers that could be targeted as we have seen in the cases of banks and cloud services which have gone down when faced with such attacks in the past. The distributed ledger is more resilient and much less vulnerable to malicious attackers (Tapscott and Tapscott, 2016). Companies can use this feature to secure internal and external data of private or financial nature from cyber crimes.

Equitable Access

Nearly two billion of the world's population is still excluded from access to the financial and economic system. In the developing world around two billion people don't even have a bank account, which is considered a gateway to financial opportunities. This is because lower income groups can't afford the minimum account balances, minimum payment amounts, or transaction fees to use the system. The high infrastructure costs related to banking and other financial operations make micropayments and micro accounts unfeasible to include these groups in the financial eco-system (Tapscott and Tapscott, 2016). Blockchain can help in financial inclusion. By removing intermediaries, blockchain reduces the overheads related to financial operations and solves the problem of scaling across borders, thus allowing possibilities to target previously excluded group of customers.

Speed

In general remittance takes three to seven days to process. Stock trades three two to three days settle whereas bank loan trades take on average a twenty-three days to settle. The SWIFT network, which handles fifteen million payment orders a day globally, requires days to clear them whereas blockchain transactions are instant or completed within minutes

(Tapscott and Tapscott, 2016). This means that companies can process transactions of money, asset or information more quickly thereby enhancing their service levels.

Efficiency

By providing a single version of all transactions across the network, blockchain provides instant visibility (Atzori, 2015; Underwood, 2016) all the parties need to perform tasks throughout the product life cycle, thus improving efficiency through automation. Further, blockchain-based systems could help drive unprecedented collaboration between participants resulting in process efficiency.

Productivity

The single window and transparent nature of blockchain makes it possible for the organizations to use it as a platform to facilitate collaboration between different levels of administration (Tapscott and Tapscott, 2016). It further ensures efficient implementation of various policies based on the terms set for different customer and suppliers directly through smart contracts, while keeping every relevant department in the administration appraised of the situation. A recent analysis and the resulting report published by Australia's Commonwealth Scientific and Industrial Research Organization (2017) has identified that blockchain adoption may lead to increased productivity and innovation.

Quality

Information stored in a blockchain system corresponds to what is being represented in reality due its distributed consensus creating mechanism (Tapscott and Tapscott, 2016). This ensures that if a transaction cannot be verified by the majority of nodes, it will be rejected. The result is higher data quality. By utilizing the blockchain to automate processes, companies may increase the integrity of data.

Cost Savings

Blockchain removes the need of intermediaries through transaction validation and recording of data on a distributed cloud. This makes it a network that has peer-to-peer or shared-cost basis. Experts say it is possible that the costs of using blockchain's computing infrastructure will be as cheap as Internet access today, on a relative per-user basis (Mougayar 2016). Costs related to transaction clearance and settlement can reduce due to removal of intermediaries (Palfreyman, 2015; Tapscott and Tapscott, 2016; Ølnes, 2016). Fraud related costs may go down due to the immutable structure of blockchain. Reconciliation, compliance

and reporting costs could reduce due to the improved data quality, transparency and auditability. Further, Identity and trust establishing cost may decline as the ledger could be used to verify information of clients or suppliers.

2.1.5 Industry applications

In order to illustrate how the attributes of blockchain may impact businesses, we briefly summarize their application in various industries. This will enable better understanding of attributes listed above and help gauge their implications later in the thesis. Some examples of industry applications are discussed below

1. Banks and financial service providers can take advantage of blockchain to increase security, speed, and operational efficiency in various domains such as settlements and clearing. The result of this could be potential lower costs for banks (Pentland et al., 2016)

2. Artists and other creative professionals can store their content on blockchain, which can act as a distributed database for content copyrights (O'Dair, 2016). Not only the rights of creators can be preserved but royalty payments can also be made fast and frictionless through blockchain.

3. Blockchain makes tracking of products possible among partners in supply chains by acting as a new and faster information sharing and document exchange solution (Korpela et al., 2017) thereby reducing time delays, administrative cost, and human errors.

4. Patient data is scattered across the database silos of various organizations, as multi-institutional systems are not integrated (Azaria et al., 2016). This means, at present, healthcare institutions find it difficult to share data across hospitals, insurers, and other parties without compromising data security and integrity. Blockchain can allow data interoperability by acting as a shared database between institutions which would lead to more accurate diagnoses, higher quality treatment and cost-effective care.

5. Blockchain technology is one of the most sophisticated tools to protect data from the increasing cyber-attacks on individuals and corporations. With its immutable structure and complex encryptions, blockchain can provide better security compared

to current security applications (Singh & Singh, 2016). Therefore, it lowers organizational risks related to data theft and corruption.

6. Sharing economy is dependent on intermediary platforms such as Uber and Airbnb to facilitate transactions between users and service providers. It has been suggested that in such models value is mostly captured by the platform (De Filippi, 2017). Blockchain can allow service providers to transact directly with users, in a peer to peer manner as opposed to being dependent on intermediaries resulting in a more fair distribution of profits

7. With Blockchain applications, title management and expediting leasing will become easier in the real estate industry as data can be stored on the network and easily shared among participants of the network (Spielman, 2016).

8. Companies that opt to use cloud services for storage are required to trust third-party providers with their business data (Stuart & Bromage, 2010). However, blockchain storage solutions build on a decentralized network, make them independent of third parties and more robust against attacks that threaten system health and data integrity

9. There are a multitude of processes and participants involved in the simplest of energy and commodity transaction. Additionally, a company has to interact with various market participant such as exchanges, brokers, logistics providers, banks, regulators and price reporters to verify and reconcile transaction data multiple times. All this creates cost and process inefficiencies which can be resolved using blockchain's transparency and transaction attributes (Basden & Cottrell, 2017).

We can see from above that though the potential uses of blockchain in various industries have been discussed in literature but we are still missing the understanding of how exactly blockchain is affecting the business models in specific industries, hence the results of our study will also contribute towards seeing the implications of blockchain on above industries.

2.2 BUSINESS MODEL

Business model is considered a relatively new research topic (Santos et al., 2009) and remains largely unexplored in academic circles (Zott & Amit, 2010). It encompasses several academic fields and unified definitions and frameworks are yet to be found among researchers. The definition of business model also vary across studies, but Saebi et al. (2017) highlight that most are close to or consistent with Teece's (2010) definition which states that a business model represents "how the enterprise creates and delivers value to customers, and then converts payments received to profits" . In our opinion, this comprehensively represents the business logic of a firm.

Zott et al.'s (2011) broad review of 133 articles on the subject of business models reveals that one of the most popular domains for business model research is e-business and the use of information technology in organization. Their findings indicate that the Internet is a principal driver for the rise of interest in business models and the resulting literature that revolves around the topic. They found that in a total of 49 studies in which the business model is clearly defined, almost one fourth relate to e-business domain. This validates our reasoning that by understanding the impact of blockchain on business models, researchers can understand this technology's implications on businesses.

Since this paper aims to highlight the impact that blockchain technology can have on business models, it is important to first discuss the concept of business model and present it in a clear and simple way. In this section, we attempt to build our knowledge about what a business model is and what essential elements it is composed of to formulate our own framework. The business model is a subject that can understood from a variety of perspectives; economic, strategic and operational (Morris et al., 2005). Therefore, we will develop and present our own point of view of the business model with four main contributions from literature; Teece (2010), Zott & Amit (2011), Osterwalder & Pigneur (2002) and Weill & Woerner (2013) supplying foundational knowledge for the elements of business model.

We chose these studies because Teece (2010) presents an overarching and holistic view of the concept of business model, whereas Zott & Amit (2011) present an analysis of more than 1200 academic articles on business models making the resulting information credible and comprehensive. Osterwalder & Pigneur (2002) and Weill & Woerner (2013) provide a

business model ontology that decomposes business model elements with increasing depth. Furthermore, they incorporate technological aspect into their business model ontologies, making their studies more relevant for our research. The proposed framework will be used later in our research to analyse the impact of blockchain technology on business model.

2.2.1 The overarching dimensions

To develop the overarching dimensions of our business model framework, we took inspiration from Teece (2010), who takes a holistic approach to the concept of business model and defines it as "the design or architecture of the value creation, delivery and capture mechanisms employed". In essence, he attempts to define the business logic of a firm with these three elements. He also acknowledges the role of business model in innovation by highlighting that managers need to excel not only at product innovation but also at business model design .

Though Teece's (2010) presents a threefold, overarching decomposition of the business models; value creation, value delivery and value capture; it is not explained explicitly and we do not find a structured framework or decomposition of these three components in his paper. Hence, we put forth our own inference to further explain these value components.

Teece (2010) seems to relate value creation with value proposition as he suggests in several instances that business model design requires segmenting the market and creating a value proposition for each segment. We argue that value proposition is concerned with what is offered to customers, so this concept can be linked to value creation. Concerning value delivery, Teece (2010) views it with respect to how to organize the production system/value chain mainly in terms of value chain considerations. Value chains transfer value from one end to the other,hence this concept can be linked to value delivery. Teece (2010) mentions that a business model also outlines the architecture of revenues, costs, and profits associated with the business enterprise. We believe, this refers to value capture as revenue models of a firm outline how the firm will make money or capture profits.

Zott et al (2011) found that research on business model suggests three themes which constitute a business model, the notion of value (value stream, customer value, value proposition), financial aspects (revenue streams, cost structures), and network architecture between the firm and its exchange partners (network relationships, logistical streams, infrastructure). Thus, in their view, the business model does not only consist of value

proposition, a revenue model, or a network of relationships; but it is made up of is all of these elements together.

Comparing the above with Teece (2010), we can equate value creation with the notion of value, value delivery with architecture of the network and value capture with financial aspects because of the similarity in the descriptors.

2.2.2 The Proposed Business Model Framework

In this section, we attempt to propose a business model framework through our understanding and interpretation of the literature. To date, most research on business models has focussed only one level, such as the meta level e.g. Teece (2010) or ontologies e.g. Osterwalder & Pigneur (2002). The problem with current, one-dimensional approaches is that they do not relate the holistic view of business models with specific elements. By merging the meta level with ontological perspectives, our proposed business model aims to converge the two approaches, thus providing businesses and researchers with combined knowledge.

The framework is based on a thorough literature review of four main contributions from the field of business model and an application of our ideas and inputs. We have, in similarity to Zot et. al. (2011) & Teece (2010), conceptualized our business model on three dimensions; (1) value creation, (2) value delivery, and (3) value capture. However, we offer a more fine-grained view of the elements and sub-elements within each dimension. Each dimension, when connected with elements and their respective sub-elements provides both a holistic and detailed view on what we perceive the business model to be.

Value Creation

The first dimension in our business model framework is value creation inspired by Teece (2010). Zot et. al. (2011) summarised the literature on business model and found that the notion of value is a common dimension among authors' work. However, as argued above, notion of value is just another name for value creation because of the similarity in their properties. The value creation dimension is further expanded into three elements; value proposition, customer experience and customer relationship.

Dimensions   Elements   Sub-elements
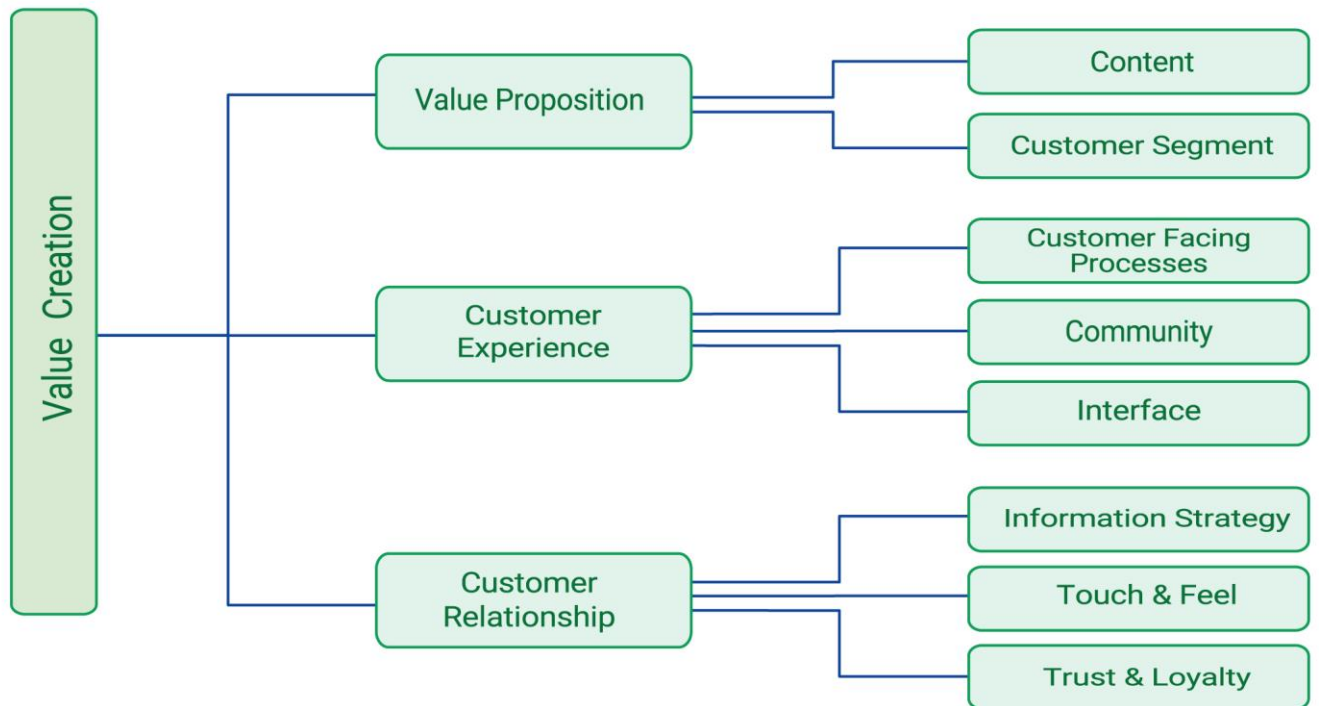
Figure 2

Value Proposition

Osterwalder & Pigneur (2002) suggest product innovation in their ontology as the element that covers all aspects related to the offering of the firm. This comprises not only its products and services but the way it differentiated from competition or a firm's value proposition; the reasons why customers will buy from a particular company rather than from competition. Product innovation also include customer segments and the capabilities required to meet customer needs. Customer segments explains which customers, geographical area and product segments a firm targets for business. Whereas, the capabilities are defined as repeatable actions in the use of resources to create, produce, and offer products and services to a market.

In our opinion, value proposition essentially creates value for the customers hence we consider it as an element extending from the value creation theme. Customer segment is considered to be the sub-element of value proposition as value proposition is designed with a specific target customers in mind (Kambil et al., 1996), thereby indirectly affecting value creation through value proposition. Different customer segment require different value proposition that is why we argue that customer segment is a sub-element of value

proposition. Customer segments allow firms to innovate through value proposition. Capabilities are repeatable patterns of action, hence it fits well with the value delivery concept and is not considered part of the value creation dimension in our framework.

The second sub-element that make up the element value proposition is content taken from Weill & Woerner (2013). Content specifies what is consumed by users. It is a firm's offering that solves a customer problem or satisfies a customer need. It includes the aspects of pricing, usage details and information alongside the product. We relate this to value creation as a company's products and offerings embody its value proposition, which is considered to be part of value creation. Although, Weill & Woerner (2013) consider it only part of a digital business model, we argue that it could be applied to any business model in general as any company would have to specify its offerings for a target market.

Customer Experience

We are rapidly moving from a product based world to a more service-based one, oriented towards customer experience. Hence, the second element of value creation in our business model framework, a contribution from Weill & Woerner (2013), is customer experience. It embodies the experience that the consumers will go through at various touch points when they decides to buy a product. Customer experience has become very important in this digital age due to increased competition, thus we include it our business model framework. The sub-elements extending from the customer experience element are customer facing processes, community & interface.

The elements have been taken from Weill & Woerner (2013), but we argue that they are not only part of the digital business model but any business model as customer experience is an important issue for any company. The first sub-element extending from customer experience element is digitized business processes that touch customers. We argue that digitized business processes may not necessarily be required to improve experience for the virtual world but the physical world as well, so we term it as 'customer facing business processes' in our framework to show their applicability to both online and physical businesses. Community has also become an important aspect of customer experience as users look for product ratings and recommendations from the community before buying a product, that is why it becomes the second element expanding upon the customer experience sub-dimension. Lee & Lochovsky (1985) define user interface as the contact point between the user and the

system. It determines to a large extent how the customer experience will be when the user interacts with the company systems or touch points.

Customer Relationship

Customer relationship is the third element extending from value creation. The inspiration for this element has been taken from Osterwalder & Pigneur (2002). Customer relationship is further decomposed into three sub elements; feel & serve, information strategy and trust & loyalty.

Feel & serve is the way a firm "goes to market" and how it actually "reaches" its customers (channels). We argue that this sub-element can include the choices a company makes to distribute its products or communicate with its customers. It is important to note that our understanding and specification of this sub-element in the framework refers to making choices about which channel to use keeping in view the target market profile and not the process or resource required to set them up.

The information strategy sub element is related to the collection and application of customer information. The objective of the information strategy is to better understand customers and to excel in customer relationships (e.g. through personalization and profiling). It is important to note here that technology channels are becoming an increasingly valuable source of discovering new and profitable business opportunities and to increase customer satisfaction, hence we consider information strategy to be an extremely important business consideration.

The third sub-element, trust & loyalty has become an essentiality of an increasingly digital world. The authors advice that trust is particularly essential between business partners when the business environment becomes increasingly virtual and the concerned parties do not necessarily know each other before engaging in business. This highlights the need to search for mechanisms such as verification and authorization, and, clear privacy policies that build trust in business environments which can lead to enhanced loyalty.

In our framework, the whole customer relationship element inspired from Osterwalder and Pigneur (2002) is considered part of value creation as it primarily deals with uncovering customers needs and meeting them with preferred channels in a trustworthy manner which then results in consumer loyalty.

Value delivery

The second dimension of our business model framework is value delivery inspired from Teece (2010), who primarily relates it to the value chain of a company. Zot et. al. (2011) identified the architecture of the network between the firm and its exchange partners as a common dimension among business model frameworks. We argue that this aspect is essentially value delivery and it comprises of elements; Infrastructure Management and Platform, in our framework.
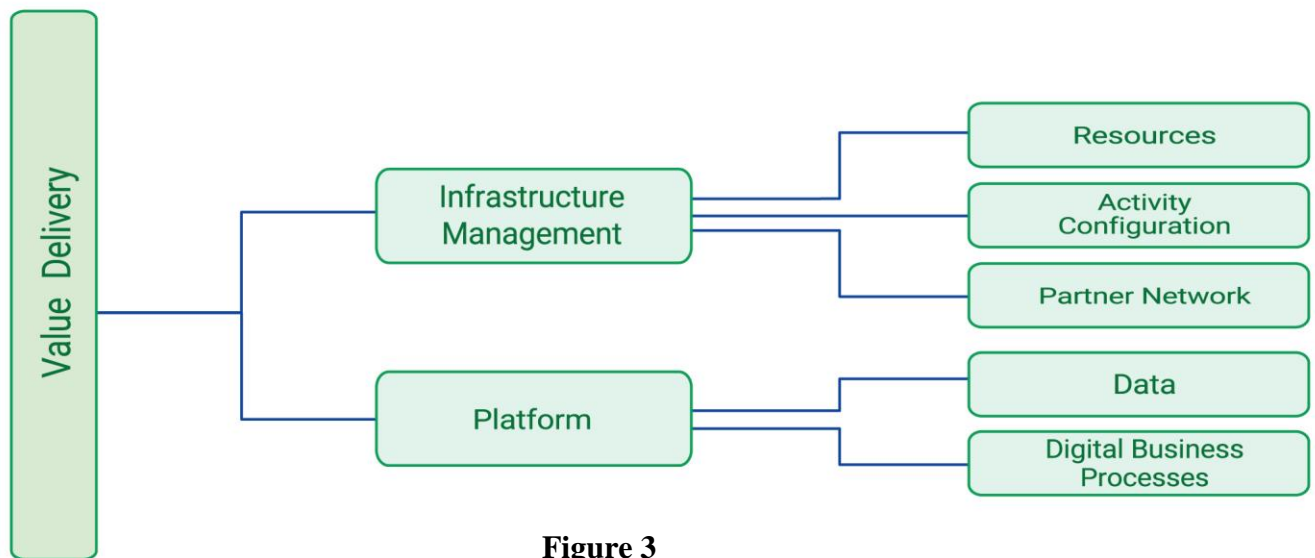
Figure 3

Infrastructure Management

The first element extending from value delivery our business model framework is infrastructure management. This element along with its sub-elements has been taken from Osterwalder & Pigneur (2002), who describe infrastructure management as the "value system configuration necessary to deliver the firm's offering". Infrastructure management is further decomposed into activity configuration, resources and partner network.

Activity configuration is the organizing and setting up of inside and outside activities and processes that leads to the creation of value that customers are willing to pay for. We think that capabilities which are also defined as process oriented, but are part of product innovation in the ontology of Osterwalder & Pigneur (2002), are a better fit under activity configuration. The partner network outlines, which elements of the activity configuration are

distributed among the partners of the firm. It can help outline the tasks done by the company itself and its partners. We argue that Osterwalder & Pigneur (2002) miss the aspect of partner relationships, hence we consider this aspect to be part of the sub-element partner network. We agree that resources include tangible, intangible, and human assets that are required to deliver value.

Platform

The second element extending from value delivery is platform and is taken from Weill & Woerner (2013). Societies are getting increasingly digital, hence companies need to find ways to connect with customers online. Platforms is a means to deliver value to customers over the internet and hence part of this dimension. A platform can be used to sell both digital and physical products. It is comprised of those sub elements that will become part of the business model when a company decides to reach its customers digitally. Weill & Woerner (2013) suggest that these sub elements are a coherent set of digitized business process (that do not touch the customer), data and infrastructure. Since infrastructure management has already been included in our business model, we only take digitized business processes and data to include as sub elements of platform in our framework. We expect businesses to add the infrastructure management related to the platform into their existing resources, activity configuration and partner network functions.

Digitized business processes are those processes that a company needs to perform internally in order to deliver value over the internet. For clarity, we have changed the term to 'digital business processes' since these processes are exclusive to the digital business of a firm. Data generated through the platform is considered to be the second sub-element of platform. We include it in our business model because in our opinion data is very important to a platform's performance particularly with reference to personalizing and targeting offers online.

By adding the digital business specific element, platform and its sub-elements, to our proposed business model, we attempt to ensure that our framework comprehensively covers both online and offline operations of a firm.

Value Capture

The third dimension of our business model framework is value capture inspired by Teece (2010) who consider it the third overarching dimension that defines the ways a company

makes money. Zot et. al. (2011) mention that financial aspects are part of the business model frameworks and was found to be common theme among various business model frameworks. We argue that the financial aspects aspects define how a company can capture value so we call it value capture in our framework. It comprises of one element only that is profitability.

Dimensions   Elements   Sub-elements
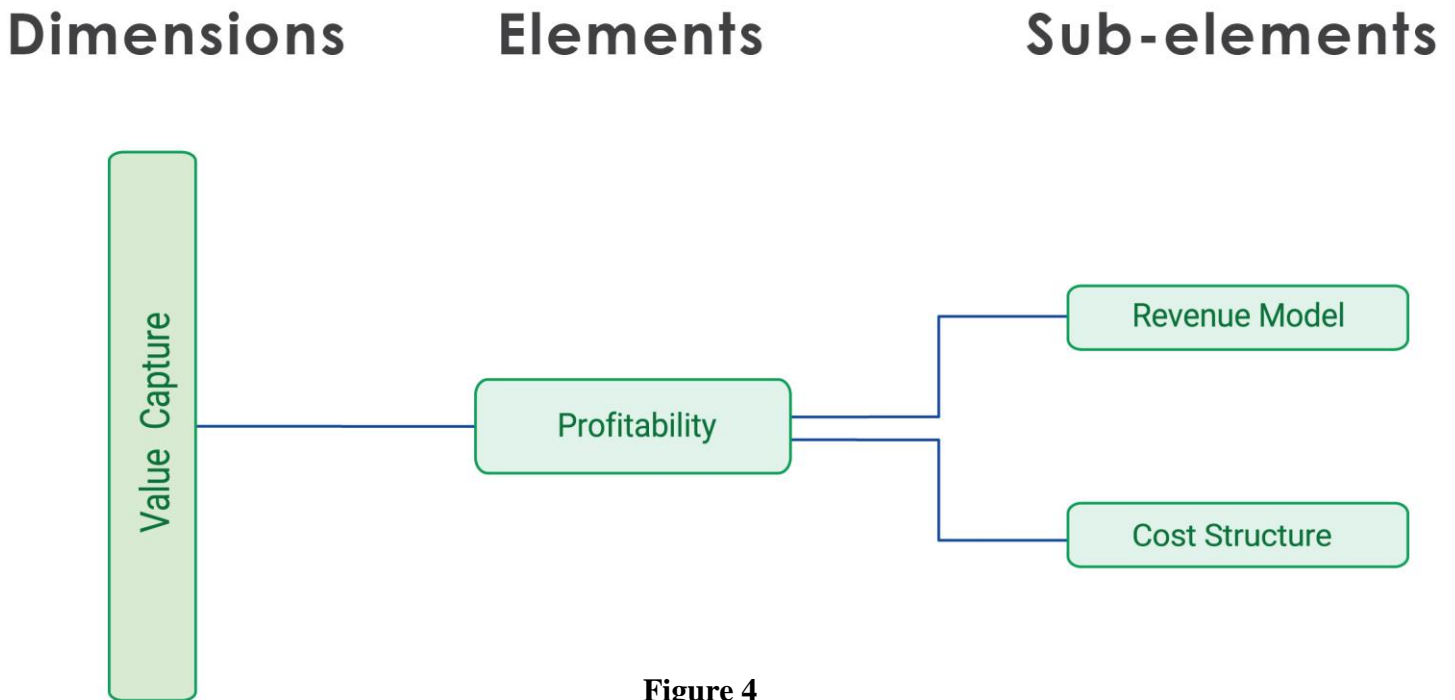
Figure 4

Profitability

Profitability is the only element in layer two extending from value capture. Firms create and deliver value for the customers in order to generate profits. The profitability is dependent on two sub elements; revenue models and cost structures. Revenue model can include different revenue streams with different pricing models. Cost structure measures all the costs the firm incurs in relation to resources, assets, activities, partner network and exchanges in order to create, market and deliver value to its customers. The profitability element is the outcome of the difference between the sub-elements revenue model and cost structure.

Summary

In sum**,** our framework provides a more comprehensive and fine-grained overview of the main dimensions and sub-elements of the business model, which has been neglected in extant business model literature. Our complete business model framework is shown in figure 5

Dimensions

Elements

Sub-elements

Value Creation

- Value Proposition
  - Content
  - Customer Segment

- Customer Experience
  - Customer Facing Processes
  - Community
  - Interface

- Customer Relationship
  - Information Strategy
  - Touch & Feel
  - Trust & Loyalty

Value Delivery

- Infrastructure Management
  - Resources
  - Activity Configuration
  - Partner Network

- Platform
  - Data
  - Digital Business Processes

Value Capture

- Profitability
  - Revenue Model
  - Cost Structure

Figure 5

3. METHODOLOGY

3.1 Research approach and strategy

A significant part of our discussion in this paper is given to the business model framework and the attributes of blockchain. We are using an inductive approach for this study as the link between business models and blockchain is a relatively new and unexplored area. Our study is exploratory in nature, as several open ended questions needed to be asked. We also felt that this flexibility was needed in our study due to lack of clarity at the start and little information on what the actual situation may be with regards to the topic under research. Flexibility ensured that we could change directions, if needed. Finally, due to the novelty of the field, an exploratory study was considered most relevant and interesting, from an academic point of view.

We decided to conduct a cross-sectional study as they are common for master thesis due to time constraints (Saunders, Lewis, & Thornhil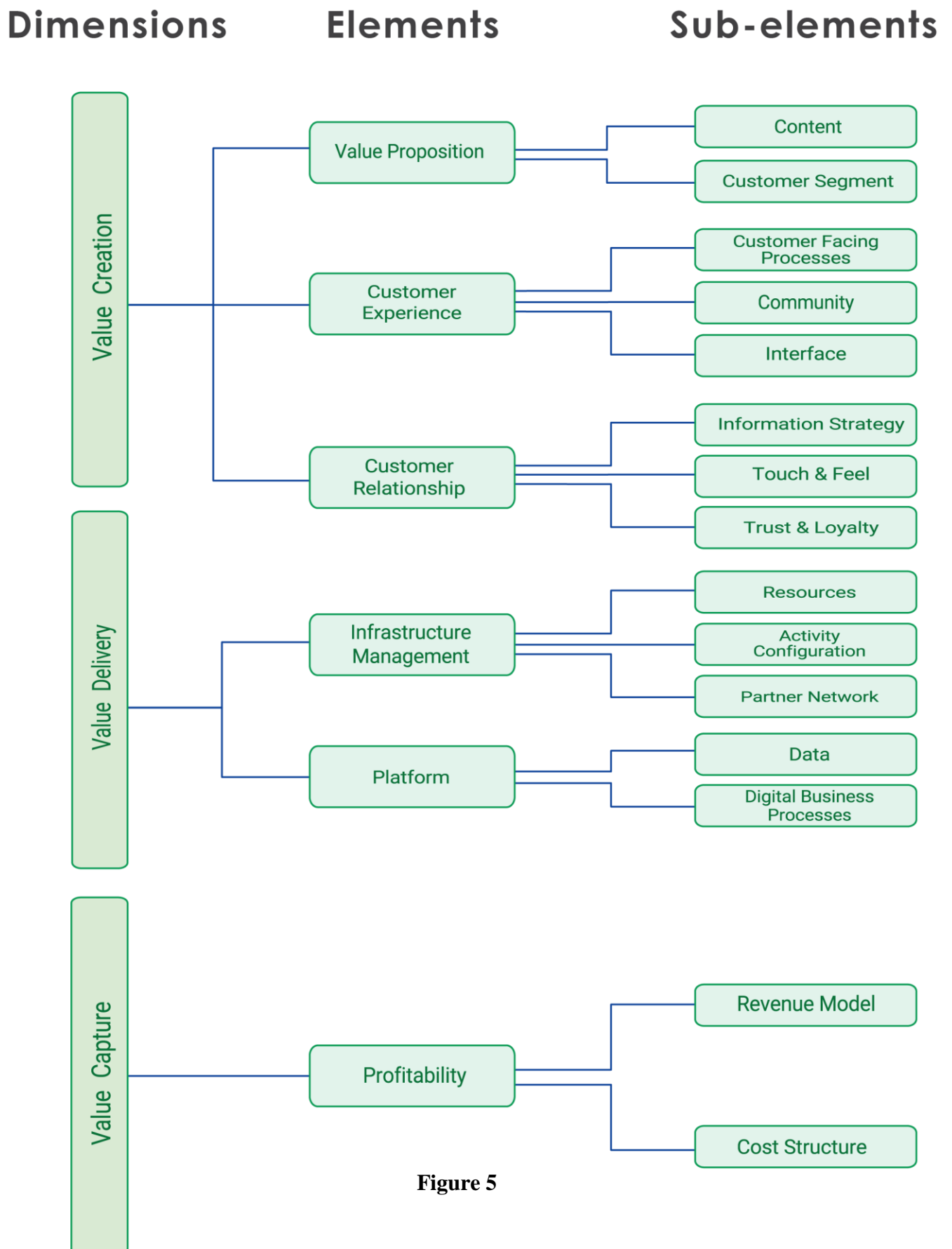l, 2012). We used the Delphi technique survey, a structured communication method that relies on a panel of experts, as our tool to do an inductive, exploratory study. The Delphi was considered appropriate for four reasons. First, we knew that we would have a small sample to work with as blockchain is a relatively new technology so the number of people who could become part of this study is relatively small. Second, the research question would have benefited from subjective judgements because precise analytical techniques could not be applied directly. Third, participants would be able to express their views freely without feeling psychologically pressured as they remain anonymous to each other resulting in elimination of subject bias (Goodman, 1986; Jeffery et al., 1995). Fourth, the population was geographically diverse so logistical constraints (such as time and cost) would make meetings unfeasible.

3.1.1 Data Collection and Analysis

Identifying a panel of experts for Delphi study is by no means straightforward (Duffield, 1988). The results of Delphi study are good as the experts who participate in it. The identification and recruitment of panel experts was done with utmost care.We determined who should be included in the study with our choice being primarily influenced by our research question. We don't consider our experts to be technical experts in blockchain instead we consider them as 'informed individuals' like McKenna (1994) recommends. We

assume that our experts have more knowledge of the topics discussed in this study than most people.

With regards to sampling, we employed non-probability sampling techniques in order to ensure the participation of right experts, who understand the blockchain technology and have the vision to forecast its impact. Panel members were recruited through three sources; first, we used our connections in the blockchain space as one of the thesis writer was part of a corporate blockchain study in the CEMS program. Second, we requested our experts to connect us with more experts in their network. Third, we contacted people who are part of blockchain startups to participate in our study (See Appendix A for the detailed list of respondents). These approaches are often adopted when the research population is hard to identify (Polit & Hungler, 1999). The composition of the sample directly relates to the validity of results, therefore, we gave considerable attention to sampling and selection.

Our selection criteria of experts takes inspiration from the generic criteria identified by Ziglio (1996) and Skulmoski et al. (2007) and consists of the following points

1. Business function experience in relation to blockchain
2. Capacity and willingness to contribute
3. Assurity that sufficient time will be dedicated
4. Good written communication skills
5. No standard academic qualifications or degrees required

Several authors have recommended the panel size of a Delphi study to be between 8 and 12 experts (Cavalli-Sforza & Ortolano, 1984; Richey et al., 1985; Novakowski & Wellar, 2008) as there is very little empirical evidence that the number of participants can affect the validity reliability of consensus processes Murphy et al. (1998). We decided to have a panel of eight experts taking into account the objective of the study and the resources available to us.

3.1.2 Number of Rounds

Delphi study has several rounds so there is a higher chance that experts withdraw from the study (Donohoe & Needham, 2008). Since our panel size was small, we expected low to none dropout rate based on the findings of Evans (1997). To further lower chances of expert

dropout, we decided to restrict our study to three rounds since Worthen and Saunders (1987) believe that attrition is most likely to occur after the third round. The experts were communicated clearly at the beginning that the study will consist of three rounds. Most of the participants requested for anonymity so we decided to offer anonymity to all participants as a strategy to keep the response rate high. A clear timeline of questionnaire rounds was provided to the experts so they can better allocate time for the study. Bork (1993), Walker & Selfe (1996) & Sumsion (1998) recommend a 70% response rate is necessary for each round to maintain rigor. However, achieving this requires considerable effort

3.1.3 Mode of Contact

We invited experts to participate in the study by contacting them through email. A brief introduction of the research topic was given along with the level commitment required for taking part in the study. We sent the questionnaires of all three rounds to participating experts by email where Google Forms was the software used for conducting survey.

3.1.4 Round One

For the first round, we decided to use the traditional approach of Delphi by conducting a qualitative round of online survey consisting of open-ended questions. Panel members were expected to provide a phrase, sentence or paragraph as a response. This approach reflected a brainstorming session (Murry & Hammons, 1995) and allowed panel members the opportunity to answer the question in detail. We were careful to avoid unclear questions that can result in ambiguous responses limiting the reliability and validity of round one. We also conducted a pilot test of the round one questionnaire before sending it out, to ensure it is appropriate. We gave considerable time to design round one questionnaire because the responses gathered from this round serve as the foundation for questionnaires made in the subsequent rounds. At the end of this round, we conducted content analysis to identify major themes among responses, a tactic considered sufficient by Powell (2003).

3.1.5 Round Two

As discussed, we designed statements for the questionnaire of Round two through the responses generated from round one. The questions were designed on a 10 point likert scale asking the panel members to agree or disagree with the statement. The panel members were given the necessary information required to complete the round. We gave considerable effort

to ensure that panel members do not drop out from this round. At the end of this round, each statement was statistically assessed for consensus among experts.

3.1.6 Round Three

Round three questionnaire consisted of statements that did not reach consensus in the previous round. This questionnaire asked panel members to review their responses in light of the mean score of the responses of all panel members. At the end of this round, each statement was again statistically assessed for consensus.

3.1.7 Level of consensus

The aim of our Delphi study was to gain consensus from the panel members on the statements we generated for round two. The statements were made through careful analysis of round one responses. Williams & Webb (1994) recommends to generate a predetermined level of consensus so we identified our level of consensus before starting the study. There is no standard threshold for consensus as this is a contentious issue in the Delphi literature but one of most commonly used is the statistical approach (Keeney et al., 2010, p.45,46), thus we will use it in our study. Rayens & Hahn (2000) defined the following criteria for consensus based a 4 point scale questionnaire

```
              Interquartile range of responses  < 1


                              OR

 Interquartile range of responses = 1 and > 60% responses in one direction
```

Since our study is based on a 10 point scale, we define attainable level of consensus to be

```
              Interquartile range of responses  < 2


                              OR

 Interquartile range of responses = 2 and > 60% responses in one direction
```

3.2 Evaluation of research

Throughout the research process, we gave considerations to the issues of validity and reliability. Concerning validity in our study, internal validity, was enforced through careful survey design. Pilot tests were conducted for surveys to ensure that respondents understood the questions clearly. The use of Delphi technique also enhances internal validity as initial responses are taken through an open first qualitative round, and the continual succession of rounds gives participants the chance to review and judge their responses. The selection of participants who have knowledge and interest in the topic can help to increase validity (Goodman 1987).

Regarding the process of data analysis, we tried to analyse qualitative data received from round one to the best of our capability. We had to infer and make interpretations from the qualitative data as our aim was to group similar statements together. Concerning quantitative data, we used a statistical method; interquartile range, to achieve consensus among panel members.

Regarding external validity, we can say that this paper had a very small sample size of eight experts with whom we conducted three rounds of survey. The existence of consensus among panel members does not indicate that the right answer was found. Consensus merely reflects how the potential benefits of blockchain could impact businesses as identified by the selected panel of experts. It is our hope and belief that the quality of data would allow us to draw sufficiently informed conclusions as our research is based on expert opinion from the 'real world'.

Regarding reliability of our study, the Delphi technique was chosen as it increases the reliability of study through the decision making process of participants by avoiding group bias and groupthink scenarios as the experts do not meet face to face (Keeney et al., 2010).

4. ANALYSIS AND FINDINGS

In this section, we will analyse the findings of our delphi method research. The Delphi technique was developed at the beginning of the cold war to forecast the impact of technology on warfare (Custer et al., 1999).It was founded on the premise that individual statistical predictions were stronger than unstructured, face to face group predictions (Kaplan et al., 1949). The Delphi method has proven a popular tool in information systems (IS) research (Mulligan, 2002; Nambisan et al., 1999; Brancheau et al., 1996). Our Delphi uses three rounds of questionnaires to gather expert responses with each questionnaire serving as foundation for the next one, we will develop the findings of our delphi study round wise.

4.1 Round One

In Round one, we took the opinion of experts by asking them how the attributes of blockchain can impact businesses (See Appendix B-1). The open ended nature of the questionnaire allowed experts complete freedom to express themselves. This decreases the risk of overlooking an aspect of the question under examination (Couper, 1984). The questionnaire consisted of one question including the list of blockchain attributes presented in the literature. To ensure clear understanding of attributes by the respondents, we included a phrase which served as an explanation of the attribute (See table 1).

In your opinion, how do the following attributes of blockchain can impact businesses?

Privacy: Protection of consumers and businesses' information

Lower fraud risk: less fraud

Transparency: Provide right information to right people through permission protocols

Security: Resilience against cyber attacks

Equitable Access: Easy access to financial system for the unbanked.

Speed: Removal of transaction time delays

Efficiency: Better coordination and decision making among organization and partners

Quality: less errors through process automation

Productivity: more work output

Cost Savings: Reduced costs for maintaining digital infrastructure

Table 1

 The questionnaire was sent to a panel of eight experts out of which six panel members replied initially. However, when we sent reminders to the other two experts they also recorded their responses making our response rate 100%, a result of our communication strategy. The responses in Round one were quite diverse, owing to the open ended nature of questions. Therefore, we conducted a thematic content analysis to identify themes of similar statements as same ideas can be worded differently. The statements were grouped with the help of affinity diagrams. Even after grouping similar statements into themes, the number of statements was still high that could have resulted in a very long and tedious round two questionnaire. Therefore, we decided to limit the statements to two per attribute as this would result in 20 survey questions for round two. We defined the selection criteria to be

For every attribute, the two most mentioned themes in expert responses were selected

4.2 Round Two

The results of Round one formed the basis for formulation of Round two questionnaire (See Appendix C-1). The questionnaire was sent to the same group of experts who participated in round one of the study. Although, it took some reminders but we were again able to achieve a 100% response rate. This highlights the level of interest taken by experts in topics researched. For this round, the questionnaire was designed based on a likert style rating of 1 to 10, allowing respondents to show their level of agreement with the statements presented in the questionnaire. The results of round two are illustrated in table 2.

Statements	Mean	IQR	More than 60% answer in one direction
Privacy			
1. Removal of intermediaries through decentralization increases customer's privacy.	8.9	1.5	-
2. Decentralization will affect businesses that utilize customer data for revenues.	7	3	-
Transparency			
1. Transparency is one of the biggest advantages a business can get by operating within a public blockchain network.	7.3	1.5	-
2. Blockchain can help develop more trustworthy ecosystems.	9.1	2	Yes
Efficiency			
1. Blockchain platforms can allow leaner data sharing infrastructure.	6.1	3	-
2. Blockchain networks enable coordination and consensus to be achieved at scale.	7.6	2.5	-
Lower fraud risk			
1. Decentralized database costs way more to break into as compared to centralized database.	5.9	4	-
2. Decentralized systems reduce the risk of data fraud and tampering.	6.6	3.5	-
Security			
1. A well designed decentralized protocol is more resilient to cyber attacks.	7.3	2.5	-
2. Blockchain may help reduce reliance on cyber security firms.	3.3	2	Yes
Equitable Access			
1. Blockchain platforms will allow inclusion of the unbanked into the financial ecosystem	8.4	2	Yes
2. Blockchain platforms are based on the premise of inclusivity not exclusivity	7.9	1.5	-
Speed			
1. Blockchain platforms can increase the speed of value transfer over the internet.	8.5	2	Yes
2. Blockchain platforms will reduce the need for time consuming paperwork required to transfer physical assets.	7.8	2	Yes
Quality			
1. Blockchain platforms can lead to greater process automation.	7.5	3.5	-
2. Blockchain platforms can rectify data input errors	2.3	2	Yes

Productivity			
1. Blockchain platforms can directly increase productivity of businesses.	2.4	2.5	-
2. Blockchain platforms can indirectly increase productivity of businesses.	8.6	1.5	-
Cost Savings			
1. Developing an internal decentralized infrastructure is less costly for businesses.	1.8	1	-
2. Blockchain enables cost savings by removing intermediaries.	7	2.5	-

Table 2

By applying IQR less than 2, we can see that only 25% of the statements achieved consensus. However, when IQR is equal to 2, it can be seen that more than 60% of responses are in the direction of either agree or disagree resulting in a total of 55% statements achieving consensus. The respondents agreed with 73% of the consensus achieved statements and disagreed with 27% of the statements. In Round 2, it became clear that experts perceived the impact of blockchain attributes on business models differently. While they reached consensus on 11 statements out of 20, nine statements obtained no consensus. Both the statements generated from attributes 'efficiency' and 'lower fraud risk' did not achieve consensus among the members of expert panel.

4.3 Round Three

The statements that did not achieve consensus in round two were made part of the round three questionnaire (See Appendix D-1). Each expert was asked to reconsider his/her responses in light of the mean responses of the expert panel. Therefore, for round three personalized questionnaires were sent to each panel member listing their individualized response along with the mean response of expert panel below each question. We were able to achieve 100% response rate from our eight experts without reminders during this round as the questionnaire took less than five minutes to submit a response. The results of round three questionnaire is presented in the table 3.

Statements	Mean	IQR	More than 60% answer in one direction
Privacy			
1. Decentralization will affect businesses that utilize customer data for revenues.	7.1	2.5	-
Efficiency			
1. Blockchain platforms can allow leaner data sharing infrastructure.	6.0	2.5	-
2. Blockchain networks enable coordination and consensus to be achieved at scale.	7.5	2	Yes
Lower fraud risk			
1. Decentralized database costs way more to break into as compared to centralized database.	6.3	3	-
2. Decentralized systems reduce the risk of data fraud and tampering.	6.6	2.5	-
Security			
1. A well designed decentralized protocol is more resilient to cyber attacks.	7.4	2	Yes
Quality			
1. Blockchain platforms can lead to greater process automation.	7.4	3	-
Productivity			
1. Blockchain platforms can directly increase productivity of businesses.	2.4	1.5	-
Cost Savings			
1. Blockchain enables cost savings by removing intermediaries.	7.3	1.5	-

Table 3

By applying the same rationale used in round two to assess consensus, we can see that the expert panel achieved consensus for four more statements making a total of 15 statements to achieve consensus. However, the experts could not achieve consensus on 25% of the statements. It should be noted that both the statements of attribute 'lower fraud risk' could not achieve consensus.

5. Discussion

From the findings, we will now infer how the specific attributes of blockchain affect the elements of business model.

5.1 Privacy

Respondents strongly agreed that privacy of consumers will increase as data will be encrypted and reside on decentralized computers. In our opinion, companies that offer such advance privacy can gain greater customer confidence, which impacts the 'trust & loyalty' element of business model. This is because customers will not have to worry about third parties invading their data privacy. This will in turn better the 'customer relationship' of companies with their customers. The attribute of privacy can also be linked to the 'content' element as this can be listed as a feature of a product or service that a company offers. This adds to the value proposition a firm offers to its target market by aiming to resolve the customer problem of privacy issues.

Consensus could not be achieved on whether decentralization will affect businesses that use customer data to generate revenue. Since this relates to the usage of data by a firm, we cannot say if this attribute would impact 'information strategy'. Overall we can say that through 'trust & loyalty' and 'content', the attribute 'privacy' can impact 'value creation'.

From the above we argue that markets, particularly in which customer privacy is valued, companies that employ blockchain may gain competitive advantage. We may also see a new breed of entrants who differentiate and position themselves by incorporating this attribute in their solutions and pose a threat to incumbents' market share. Further, as the incidents related to privacy breaches increase and consumers become more aware of this, they may demand or expect more privacy options in products and services. In this case companies who are to able satisfy this need will be favored more by the customers.

5.2 Transparency

Respondents strongly acknowledged transparency to be an attribute of blockchain that results in a trustworthy ecosystem. Transparency means true information is openly accessible

to relevant people. If companies have validated information about their products, services or operations available to customers, this can enhance the 'trust & loyalty' customers have on an organization and result in more open 'customer relationships', which then facilitates 'value creation'. We also see transparency affecting the 'partner network'. This is because validated information in the network would make collaboration better and partnerships more trustworthy by reducing checks and balances done in relation to partners, resulting in ease of infrastructure management. This can therefore impact 'value delivery'.

Transparency was also highlighted as one of the biggest advantages a business can get through public blockchain. We infer from this that at present achieving transparency in a business network is an important concern for firms and blockchain can provide a possible solution to this. This will be particularly advantageous to sectors where network dependencies are high or where many participants are required to deliver a product to market. Also, firms who verify information on behalf of users or companies may not remain as competitive. We can also expect companies and governments to become more accountable to public as their operations would become auditable to public as a result of blockchain adoption.

5.3 Equitable Access

Respondents strongly agreed that blockchain is an inclusive technology that can help companies serve new segments of customers. In particular, respondents noted that blockchain can help target the unbanked 'customer segment'. This is because new sets of 'value propositions' such as lower transactions fees needed to target the unbanked can be made possible with blockchain particularly in the developing world as highlighted by respondents. By giving access to more customers, blockchain can also provide a new source of revenue and profitability for firms. This attribute can thus impact both the 'value creation' and 'value capture' dimension of a business model.

From the above we can say that blockchain can be used as a tool to increase financial equality in the developing world. This could be done in several ways such as via a blockchain based banking service that can process monetary transactions, facilitate peer-to-peer micro credits and allow investment opportunities for the lower income groups.

5.4 Efficiency

Respondents moderately agreed that blockchain can allow coordination and consensus to be achieved at scale by acting as a common database among multiple parties with permissioned access. By removing inherent information delays and bottlenecks associated with multiple databases , 'partner networks' can become more efficient. 'Activity configuration' of a firm may also improve as multiple parties can collaborate, decide on issues and organize needed activities more efficiently due to the interoperability of data allowed by the shared ledger. Though respondents highlighted that data sharing with blockchain results in efficiency, consensus could not be achieved on whether blockchain would make the data sharing infrastructure leaner. Thus, we cannot conclude if this attribute would reduce the 'resource' required by a company to deliver value.

We argue from above that both front end and back end operations of a company can benefit from faster turnaround time due to the visibility and connectivity provided by blockchain. Further, with blockchain, managers can expedite decisions because they can have access to relevant information in the entire business network and not just the information residing on company servers.

5.5 Speed

Experts strongly agreed that blockchain can increase the speed of value transfer over the internet because of its peer to peer nature and the resulting reduction in lead time due to lesser intermediaries. For example, international remittance service normally takes a few days to transmit funds, whereas on blockchain this can be done within minutes. The blockchain based value transfer has a clear edge over existing services. Exchange services can incorporate blockchain to speed up their 'customer facing processes' related to money and other asset transfers.

Another interesting perspective on which respondents moderately agreed to was that blockchain can reduce the time consuming paper work associated with the transfer of physical asset such as real estate. Once the digital and verified version of a physical asset has been stored on blockchain, it can be easily exchanged between parties. This digitization of 'customer facing process' would lead to reduced time delays in physical asset transfer, thus

enhancing 'customer experience'. Overall , we see that for intermediaries facilitating value exchange and for firms selling physical assets, blockchains can bolster their 'value creation'.

From the above we can suggest that blockchain enabled exchange services have the potential to replace firms that at present facilitate transfer of tangible or intangible assets. Due to the speed, global access and lower costs associated with blockchain based asset transfers, customers are more likely to favor it. In our opinion intermediaries who provide exchange services in the market face a high risk of losing market share from blockchain penetration.

5.6 Cost Savings

Respondents strongly agreed that developing blockchain infrastructure independently will be costly for businesses, hence we do not recommend this approach towards adopting blockchain. Instead companies can either use existing blockchain infrastructure services or build it in partnership with other parties as suggested by respondents. We can see this in practice in the form of HyperLedger or IBM Maersk alliance, which are joint partnerships to develop blockchain infrastructure.

Experts had moderate agreement that real financial benefits from blockchain come from cost savings made possible due to the removal of intermediaries. Blockchain based transaction fees are comparatively very low as advised by the expert panel. To add to this, by replacing traditionally fragmented database systems firms use, blockchain solutions can reduce or eliminate costs associated with replicating and distributing data. We therefore, see blockchain improving the 'profitability' through savings in the 'cost structure' of a firm.

We gather from above that companies who regularly require authentication, transaction processing and contract services in order to operate their businesses can gain cost advantages via blockchain. Whereas the revenues of companies who provide such services face threat from blockchain.

5.7 Lower fraud risk

Consensus could not be achieved that decentralised systems reduce the risk of data fraud and tampering or that blockchain based database is more costly to break in comparison to a centralized database. The immutability of a blockchain depends on the number of nodes on

the network. The more the nodes, the more cost would be needed to tamper data on all nodes. Hence, some experts think that if a decentralised network does not have enough nodes, this attribute will not stay effective. However others are of the opinion, that organizations will only move to that blockchain network which has enough nodes to make tampering extremely difficult, making this attribute effective. If future research does conclude in favor of the latter expert opinion, we see this primarily impacting 'cost structure' of businesses, as frauds incur monetary losses for companies. This attribute, if effective, can also enhance the 'trust and loyalty' among customers as blockchain can verify the authenticity and provenance of a product.

From above, we suggest that firms looking to take advantage of the immutability of blockchain to lower fraud risks, should ensure that the blockchain network has enough nodes to make data tampering extremely difficult. Also, a blockchain network that can provide immutability will be very beneficial for industries in which high costs are incurred in order to investigate the accuracy of claims and documents.

5.8 Security

Respondents moderately agreed that a well designed decentralized protocol is more resilient to cyber attacks as data is distributed and protected with encryptions. This can result in assuring customers that their information is safe with a firm leading to increased 'trust & loyalty'. Further, 'partner network' relationships can also become more open when data is considered safe with a company. A company's 'revenue' may also be compromised if confidential information is leaked. Based on this, blockchain's security attribute can assist companies with better value creation, delivery and capture.

It is important to note that we did not find this attribute to impact 'cost structure' of a firm as experts strongly indicated that blockchain does not reduce reliance on cyber security firms. In our opinion, this is because companies will still have to pay fees to cyber security firms that offer blockchain based security solution, hence the cost will remain intact.

5.9 Quality

Respondents strongly agreed that quality of data cannot be increased by blockchain as it cannot rectify data input errors. However we argue that this is not the shortcoming of the system if the initial data that is migrated on it is corrupt.

Respondents could not have consensus that blockchain can lead to process automation which entail less human errors relating to data. This means we cannot conclude if blockchain will automate firms' internal and external work processes and thereby impact the quality of 'customer facing processes', 'digital business processes' or 'activity configuration' with this attribute.

5.10 Productivity

Respondents strongly agreed that productivity is not enhanced by blockchain directly but indirectly due to speed, process automation, transparency and efficiency. Due to speed, transparency and efficiency, the turnaround time for decisions, actions, activities and processes reduces and more work can be done with the additional free capacity. This will impact 'activity configuration' as setting up and organizing activities will become faster. Similarly 'digital business processes' and ' customer facing processes' will have faster turnaround times leading to more output. This shows that by indirectly increasing productivity, blockchain can impact both the 'value creation' and 'value delivery' of a firm. We infer from above that by increasing the productivity, blockchain provides firms opportunity to supply more products or services and thereby better satisfy market demand.

Summary

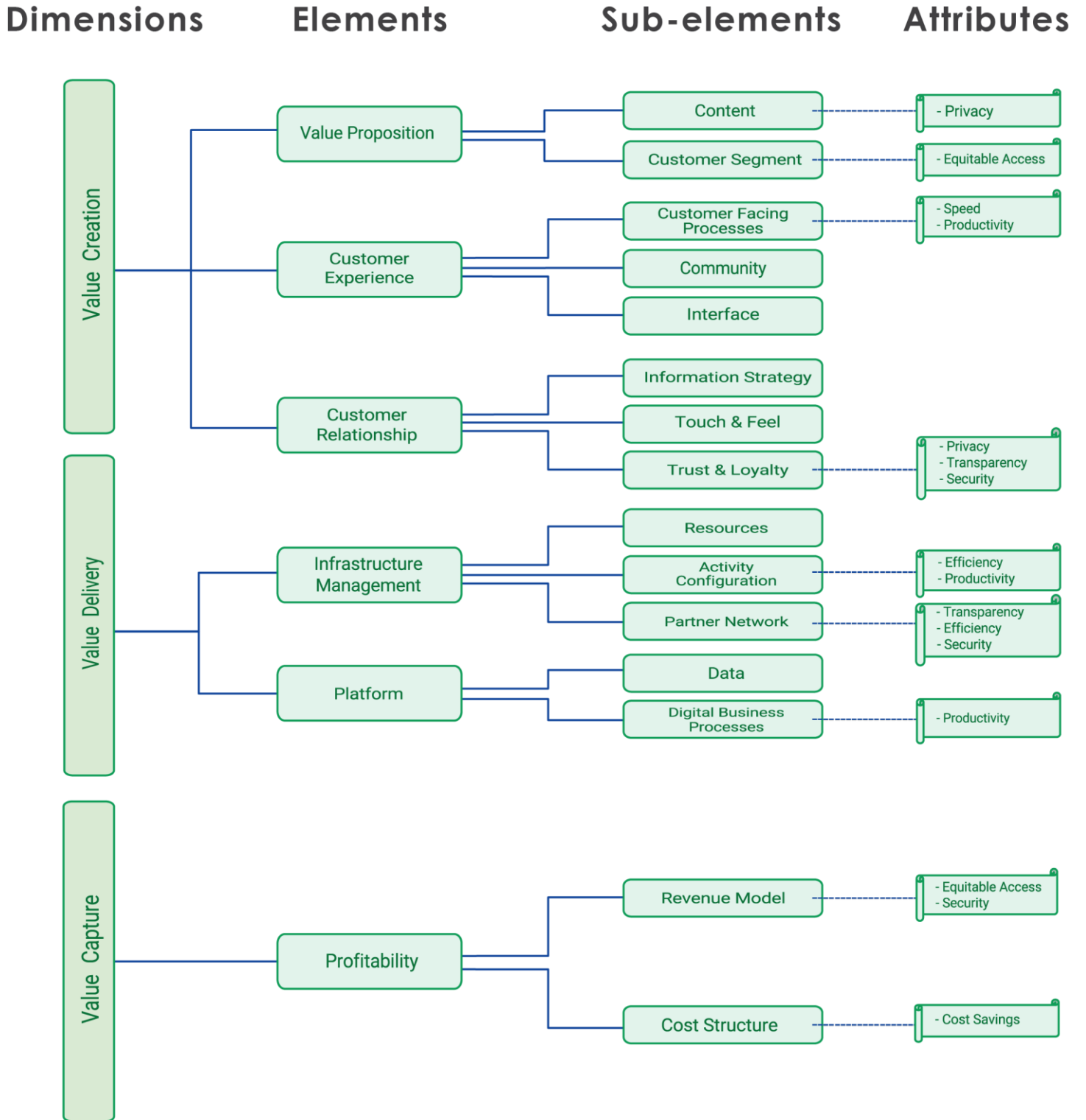To sum up, the impact of blockchain attributes on business model is represented in figure 6.

Figure 6

6. Implications

6.1 For Research

This paper adds to the blockchain literature by highlighting the impact blockchain can have on business models of firms. A synthesized view of blockchain attributes was presented and every attribute was gauged for its impact on business model. Our findings indicate that this technology can prove to be disruptive for incumbents as it impacts various elements of the business model.

In this paper, we also presented our own perception of the business model framework. We feel that our model is useful as it incorporates the digital business aspect of firms as well. It is our perception that our model was able to quite extensively highlight the effect that blockchain technology can have on businesses that can become the foundation for several recommendations that might be helpful to companies.

6.2 For Practitioners

This paper identifies the elements of business models through which blockchain technology can possibly affect incumbents. However, each industry has its own dynamics e.g. for a certain industry, the privacy attribute of blockchain may not matter a lot. So, managers should first consider their market context before using the findings of this research. Based on the industry specific information presented in the literature review, we now discuss the implications of our findings for manager.

1. Industries such as financial services and real estate suffer from delays and operational costs related to transaction processing, which hampers customer experience. In our opinion this industry can use the 'speed' attribute of blockchain and make their 'customer facing processes' related to transaction clearing more efficient. Financial service industry such as banks, loans and investment firms can also use the 'equitable access' attribute of blockchain to target a new market and add a new 'customer segment' to their portfolio which can become an added 'revenue stream' for their business models.

2. Medical sector finds it difficult to share patient data as information is scattered across individual databases. By using 'transparency' attribute of blockchain, health organization can create gain data interoperability which will increase customer's 'trust & loyalty' whereas enhanced collaborations among partners will make the 'partners network' more effective in delivering better medical care to users. Same applies to supply chain and energy as the former can benefit from provenance and tracking of goods where as the later can benefit from timely information sharing. Blockchain's 'transparency' attribute can thus be expected to improve customer relationships and partner networking in these industry too.

3. By using a shared digital ledger with enough nodes to prevent data tampering, industries such as insurance can reduce frauds because the shared ledger presents the same updated and true information to all member of the value chain. Participants can check the history and authentication of insurance claims, so fraudulent transactions are easier to identify resulting in savings for 'cost structure'.

4. Customers' concerns with regards to storing data on cloud is due to data residing on the centralized servers of cloud storage companies making it accessible to them. Companies in cloud storage can use the privacy feature of blockchain to introduce 'trust' in their 'customer relationships' by assuring customers that their data is on blockchain and hence not accessible to the storage provider.

5. Industries that depend on sensitive information, intellectual property or original content for revenues can benefit from immutable structure and complex encryptions of blockchain to make its data more secure. For example financial services can drive more 'trust' in their customer relationships by assuring data safety and corruption. Similarly media industry, can protect original content against copyrights by using blockchain as the defense mechanism against cyber theft, which means the 'partner network' comprising of artists may feel more secure about their content rights being protected.

6. Any industry that is dependent on intermediaries to carry out verifications, exchange and contracts can achieve savings with respect to 'cost structure'. For example, firms can directly receive payments from customers online rather than paying intermediaries such as Visa for processing transactions and thus save costs due to comparatively low transaction fees.We may also see a new model of sharing economy based on direct transactions between service providers and users with much lower transactions fees.

7. Limitations

The novelty and value in the proposed business model framework is that it combines the overarching business model dimensions with specific elements allowing companies to analyse potential changes in their businesses from both a holistic and specific perspective in the advent of a technology. While our framework attempts to gather the most salient findings from the most relevant theoretical sources, it is by no means a completely exhaustive approach, therefore we advise readers to use our framework in considerations with their business context. Further, in our thesis we have not explored the dependencies or the significance of elements in relation to each other. We feel this should be left to the interpretation of the readers and their organizational context as this would allow flexibility in configuring a business model.

Limitation associated with the finding of the research arise from the chosen method; Delphi Technique. There are no established rules to guide Delphi studies, which means that standardization of results may be compromised. The reliability and credibility of the results from Delphi are only as good as its panel members. Since there were no given criteria for panel selection, size or composition, the validity of the results may be compromised. Due to non-availability of guidelines, the selection of panel was based on self assessment which may introduce researcher's bias into the study. Though subject bias is reduced as each member can express their opinions and views freely due to the ensured anonymity, however it may also make respondents' not take responsibility for their feedback, consequently affecting the quality of research findings. There are also limitations related to group pressure. Respondents may change their opinion based on new information sent to them in the next rounds to conform to majority's opinion resulting in artificial consensus on statements. Personal bias and situational analysis is also difficult to eliminate as the foundation of Delphi study relies on judgements (Kahneman et al., 1982). It should also be noted that blockchain based platforms have received an unprecedented interest this year, hence respondents may have fallen victim to the hype and not voiced their true opinions.

8. Future Research

Blockchain is an emerging topic of research, hence there can be many possible topics that explore the convergence of blockchain and business. Some ideas for future research can come from the limitations of this study. To start off, researchers may analyse the thesis topic with a different research methodology to validate the findings and contribute towards standardizing the results. They may also increase the depth of the thesis topic by researching the implications of blockchain on a particular industry in detail. Further, studies from the perspective of startups may also reveal important insights on how blockchain may enable completely new business models.

Researchers may also be interested in exploring the significance and dependencies of our framework's elements with each other in the the context of a particular industry. It will also be worthwhile to see how the significance and dependencies of the components vary from industry to industry. Finally, we welcome critique on our framework as there is possibility that there may be other significant elements of business model that we may have missed due to our literature review not being completely exhaustive.

9. Conclusion

The aim of this research was to study the impact of blockchain on business models. Since blockchain is an emerging technology that is considered to be as disruptive as internet, this research is timely and much needed. The results of the study indicate that blockchain affects all three dimensions (value creation, delivery & capture) of a business model with its different attributes.

Based on this, we conclude that blockchain has the potential to facilitate significant innovation in the business model of certain firms. These include companies whose operations are highly dependent on data verification, interoperability and transaction processing. The results also apply to companies for whom maintaining data privacy and security are important concerns. We hope that the results of this thesis put significant contribution to practice and literature and lays the groundwork for future research on blockchain and business models.

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Appendices

Appendix - A

List of Participants

Respondent #	Position	Company
1.	Director & Cofounder	Blockchain startup
2.	Head of Operations	Telecom Multinational
3.	Head of Lab	Finnish financial group
4.	Solutions Architect & Software Engineer	Self-employed
5.	Chief Executive Officer	Blockchain Startup
6.	Head of Supply Chain	Danish Logistics firm
7.	Chief Operating Officer	Blockchain Startup
8.	Blockchain Protocol Engineer	Blockchain Startup

Appendix - B-1

Questionnaire Round One

Impact of Blockchain on Business Models

Thank you for taking your time to participate in this study. Rest assured, all the answers you provide will be kept confidential. The study is on the topic; "Impact of blockchain on businesses"conducted by students of Norwegian School of Economics (NHH) as part of their master thesis. The study will help identify how the current business model of firms will

change or new business models will emerge in the coming years due to blockchain technology

We have identified certain attributes of Blockchain technology through literature review and want to learn how these attributes can impact businesses. For this purpose, we are conducting a Delphi method research with a maximum of three rounds. This questionnaire (Round one) comprises of open-ended questions. Based on the responses of this round, statements for round two will be made.

In your opinion, how do the following attributes of blockchain can impact businesses?

Privacy: Protection of consumers and businesses' information

Your Answer

Lower fraud risk: less fraud

Your Answer

Transparency: Provide right information to right people through permission protocols

Your Answer

Security: Resilience against cyber attacks

Your Answer

Equitable Access: Easy access to financial system for the unbanked.

Your Answer

Speed: Removal of transaction time delays

Your Answer

Efficiency: Better coordination and decision making among organization and partners

Your Answer

Quality: less errors through process automation

Your Answer

Productivity: more work output

Your Answer

Cost Savings: Reduced costs for maintaining digital infrastructure

Your Answer

Appendix - B-2

Round One Responses

Below are the round one responses attribute wise.

Privacy

Respondent 1

Owing that more data will be transacted on a public ledger, greater attention will be paid by businesses to ensure privacy of individual's data

Respondent 2

The primary benefits I see are towards the consumer's side: a popular theme of decentralization is disintermediating existing companies that use their power as the service gateway to track you and profit off of data you either purposely or accidentally provide; think of things like ad retargeting, preferences, uber trip details, etc. If we remove the third party that collects that information, the consumer's privacy is more protected; see what Brave is doing as a good example. There's also the "you own your data" ethos in the blockchain ecosystem; since the user can be put in charge of their data and their own privacy, they may protect it much more than a business would (although that may not be the case in real life, since protecting your privacy isn't very easy).

Respondent 3

Blockchain can make management of privacy easier and more feasible for the consumers

Respondent 4

Blockchain (Distributed Ledger to be more precise) -based identity solutions (like Sovrin, UPort) change dramatically the approach to privacy handling. New business models, stronger focus on privacy enhancing features will be a core driver of digital identity development in coming years.

Respondent 5

Privacy in a growing concern among governments and consumers. In future, companies that offer better privacy measures to protect consumer data may be favored more by both consumers and governments. Companies that either process consumer data regularly or rely on it for revenues may be disrupted by startups that offer blockchain based solutions such as social media on blockchain or transaction processing via blockchain. Also , since data storage is more private on blockchain, companies may gain advantage by storing their own business data or by offering storage on blockchain which has lesser chance of being monitored or accessed by third parties. Hence, companies in data storage such as google cloud may get affected by blockchain. Another advantage of blockchain privacy is consumer control of data which means new business models that allow consumers to earn from trading their information may also emerge.

Respondent 6

Privacy of data for both customers and businesses using blockchain technology will be increase when compared to data stored in a centralised location. We frequently hear of news about breach of customer data from well established businesses that spend billions of dollars on software to protect their data but are hacked.

Respondent 7

Traditional businesses rely on data stored in a central location and intermediaries for some parts of the services they offer. This makes the data prone to hacking or breach plus the involvement of intermediaries can possibly make it easier for the data to get in the wrong

hands. Blockchain can address both these issues by removing the need to store data at a central location and remove the intermediaries thus improving privacy.

Respondent 8

Privacy of data is the most discussed topic as it directly impacts the consumers who put their trust in companies to ensure their private data will not be shared by third parties. Blockchain enabled platforms will provide the power to the consumers to maintain the custody of the data with themselves and share the same with third parties only if they deem it necessary. Companies whose core business model is based on data storage services such a Dropbox may also benefit by moving onto blockchain as it will provide a more secure and trustworthy method of storing data. Also, Businesses that earn their revenues from customer data insights such as Facebook may be affected from decentralization as it takes away the sole control of the data from the business and makes it easier for the consumer to control their own data.

Transparency

Respondent 1

Transparency and auditability should become more of the norm rather than the exception

Respondent 2

Transparency is one of the biggest advantages a business can get by operating within a public blockchain network; see the Request Network for example. Everyone can verify their operations, making it much more transparent. There are also DAOs and decentralized corporations (perhaps using Aragon) that operate in this public manner; decisions and voting are part of public records and are transparent by default.

Respondent 3

In my opinion this is one of the most favorable benefits of blockchain

Respondent 4

Transparency will be key characteristics in certain sectors, like supply chain and finance. They enable more trustworthy ecosystems and thus new business models as well.

Respondent 5

Interoperability solutions in industries where data cannot be shared on cloud due to concerns of hack will be possible due to blockchain. For example, in health care data permissions can be given to only specific users allowing collabrotion and better treatment which is a great hindrance right now. Quick and real time data sharing can also be made possible in supplychain by giving access to the right partners in the network. Also governments can be made more transparent by allowing citizens to view information such as financial spendings on public blockchain.

Respondent 6

Transparency is of essence in the blockchain ecosystem. Even with permissioned blockchain ledgers, human intervention in terms of manipulating data is not possible as everything is based on programming codes and rules unlike the traditional databases where a DB administrator is able to make changes.

Respondent 7

The essence of a public blockchains or more specifically a distributed ledger system is to provide the stakeholders the ability to view and access information normally not accessible in a centralised system. When information is available instantly, it makes the system more trustworthy for all parties.

Respondent 8

A distributed ledger system provides access to all it's user which makes it more trustworthy instead of a centralised system where the DB administrator is able to make changes to the data. In the case of more confidential data such as medical records and insurance claims, permissioned blockchains remove the risk of any third party accessing the ledger as only the related parties are given access to the ledger.

Efficiency

Respondent 1

Coordination and consensus can now be achieved at scale, and between both human and non-human actors in the network

Respondent 2

In general, I think efficiency (at a microscale) is harmed by adopting blockchain technology; development time is longer, you have to architect your systems differently, etc. If you're aiming for efficiency within an organization when building a business, just using traditional technology will be loads faster. Where efficiency may kick in is towards network adoption and interactions between different parties that need to agree on shared state; if your platform is running on a public blockchain network, anyone can adopt it without jumping through hoops. The data-exchange format can also be standardized, which increases efficiency as well.

Respondent 3

Data sharing infrastructure can be potentially built to be more leaner that should improve efficiency at some level

Respondent 4

Efficiency comes through transparency, since there's less integrations, less overhead of waiting for information to be shared.

Respondent 5

Blockchain allows a safer way to share data and execute contracts across organizations without the need of third party verification delays leading to faster processing of tasks. Companies can also pass on this benefit to their customers by executing their orders or services more quickly, e.g. in insurance a claim can be paid as soon as the terms or conditions of the insurance contract are met.

Respondent 6

Organizations and their partners using the blockchain technology will be in a position to make better decisions and coordinate more effectively. This is because blockchain tech will

allow them to use a common database / ledger with permissioned access provided to partners thereby removing the possibility of bottlenecks and delays inherent in using multiple systems. In a traditional system, it is a commonplace in the logistics supply chain where marine cargo is delivered from point A to B through using conventional systems that requires the use of multiple systems to track and trace the location of cargo.

Respondent 7

The use of multiple systems in businesses - sometimes even within the same organisation creates inefficiencies as it takes much longer to take decisions and coordinate since systems are sometimes working in silos. Permissioned blockchain or distributed ledger technology will removes this inefficiency by providing data access to the stakeholders within a global system that uses a universal language and format understandable by everyone.

Respondent 8

Coordination and consensus is no doubt a big advantage of blockchain however this my depend on the size of business and the cost a business is willing to incur. As for example, blockchain may benefit a large company with adequate resources to engage in blockchain as the business maybe spread globally with multiple systems to conduct data insights and assist in decision making. This may not be the case with a small company which may have just one centralised system at their disposal.

Lower Fraud Risk

Respondent 1
Perhaps not lower risk, but more measurable risk and ease to identify the source of fraudulent/incorrect data.

Respondent 2

Centralized systems have much better ways to reduce fraud and attack vectors; running a platform on a public network requires a lot of thinking about game theory and attack vectors. The usual solution is to add an economic incentive layer to compact spam and increase quality of interactions, but if your platform needs large fraud/identity guarantees, it's worth thinking about whether or not you need a blockchain.
Public blockchains are, however, very suited to being tamper-proof. Due to the built-in

economic incentives, an attacker usually needs large amounts of capital to tamper with state. This is generally way more than the cost of breaking into a centralized database.

Respondent 3

Minor positive impact due to the improved transparency

Respondent 4

This is a cornerstone and a key driver of adoption, since decentralized systems will increase ecosystem creations, that in turn, require trust in ecosystem partners. Tamper-proof systems are a cornerstone in the ecosystems. If tampering is found, then trust in the whole technology is going to be shaken.

Respondent 5

Since blockchain infrastructure is very difficult to tamper, this would mean companies may save costs on fraudulent transactions. For example, in medical insurance, frauds results in heavy costs for companies each year. This means not only existing insurance and other fraud prone industries can take advantage of this benefit but also startups can look at this benefit and build a business around it.

Respondent 6

Risk of fraud and tampering will be minimised because data is not stored at one location instead it is spread globally in the form of nodes and each node represent the history of transactions starting from the genesis block. Even if a hacker wishes to commit fraud, it would require enormous amount of both human and financial resources to attack the nodes which makes it financially infeasible.

Respondent 7

Since decentralised ledger systems are spread beyond the boundaries of an organisation, and data is not in one place but is spread across millions of nodes globally, this makes it difficult for someone to commit fraud or temper with this data.

Respondent 8

Public blockchain have proved to be perhaps low risk when it comes to hacking and fraud. Bitcoin has been on the public blockchain for several years and so far there has not been an instance of a maliciuos attack. The important thing to consider for a business is whether in the case of permissioned blockchains which is more feasible for businesses dealing with sensitive and confidential data, would switching to permissioned blockchains be a good idea in terms of cost and improved security.

Security

Respondent 1

In use cases where the state or record of a transaction is evidenced on a blockchain then there is far reduced reliance on internal systems to maintain the source of truth, by extension a company may be more resilient to cyber attacks as they can rebuild internal systems while the state was still accurately tracked on a blockchain.

Respondent 2

A well designed decentralized protocol is perhaps more secure than a centralized and fully-controlled ecosystem; see how bitcoin's network value drives the cost required to alter history: this cost is probably way more than it would cost to break into a single database.

That said, this also applies at the lower economic scales; there are hundreds of cryptocurrency projects with market caps less than, say $10k, which anyone could completely compromise using $5k or less.

Respondent 3

Minor positive impact based on the current experiences; potential risks are perhaps related more on the individual's behavior than just technology

Respondent 4

Use of siloed platforms are leading to increasingly many hacks and leaks of private information.

Respondent 5

Companies will be wanting to find solutions, where they are not the only ones bearing the risks. Blockchain can better safeguard companies and customers against cyber attacks, it may challenge existing businesses such as anti-virus and firewall infrastructure providers, particularly when in the recent past there have been several successful hacks.

Respondent 6

More resilient as it is decentralised and would require at least 51 percent of the nodes in theory to become malicious to carry out an attack.

Respondent 7

Blockchain supports here.

Respondent 8

The more bigger the decentralized network, the more it will be resilient against malicious attacks

Equitable Access

Respondent 1

The network effects of blockchains naturally encourage a participatory and egalitarian approach to allow as many equal actors to transact on a ledger with common incentives to maintain the integrity of the ledger.

Respondent 2

Public blockchain platforms almost immediate provide better and more equitable access to the unbanked than a centralized solution. By default they operate without anyone's permission, which has the possibility to circumvent governmental roadblocks. These platforms can also be restricted, though, in a few ways, namely centralization of nodes and service providers.

Respondent 3

At the first phases on blockchain implementations the impact of this can be relatively small.

Respondent 4

Financial ecosystems will begin to spread to previously 'unbanked' and enable more security and trust for those that previously have not had that. Will be most beneficial in developing countries, but less of a disruptor in western world.

Respondent 5

Banking is still a tedious and expensive process which is accessible to only those individuals who have a certain amount of wealth. With blockchain, banks may no longer be needed and due to the low fees associated with blockchain, it will be much easier to tap the market segment that consists of low income groups. It may even bring credit and investment opportunities that are not available to such groups at the moment.

Respondent 6

It definitely provides easy access to the unbanked since banks require excessive documentation to open an account and being able to conduct financial transactions. Whereas in the case of blockchain and for that matter cryptocurrencies , all you need is an internet connection to be able to buy / sells, send / receive funds from any part of the globe. There is no discrimination as to who can be a part of this eco system as it is based on the premise of inclusivity not exclusivity.

Respondent 7

In this day and age, there are still billions of unbanked people globally who are unable to access the financial services due to the stringent identification documentation requirements that are a prerequisite for opening a bank account. Blockchain is essentially changing all this by enabling individuals to conduct financial transaction with anyone in any part of the globe without the need of a trusted intermediary and expensive fees in a matter of minutes rather than days.

Respondent 8

The essence of public blockchain is encourage inclusivity and equitable access to all. For example, anyone with an internet connection is able to buy / sell, send / receive bitcoins.

Unbanked population can easily make use of the blockchain to carry out their financial transactions without depending on the banks or businesses like western union.

Speed

Respondent 1

no impact

Respondent 2

Speed can be accelerated or hindered by public blockchain networks; it all depends on the level of trust between parties. If two parties trust each other completely, there's no need for a blockchain. In the case of partial trust in a permissioned blockchain or similar, the speed benefits can be significant, removing the need for, say 24-hour validation periods. In a trustless network, the speed takes a hit; few networks pass 10 second block times, simply due to the coordination required to agree on transaction ordering. Speed and trust are almost always at odds with each other.

Respondent 3

Lead Time should be improved when less intermediaries are not needed to manage transactions

Respondent 4

Especially disrupting in financial services, also somewhat important in other sectors. Other sectors have already benefitted speed from other technological advancements, like cloud services, DevOps, APIs, etc.

Respondent 5

Not only high cost but also excessive time is required for payments and transfers with the current banking system. Even money transfer services take atleast a day to transfer funds. Business models based on blockchain may emerge that allow swift and secure transfers across borders within minutes or seconds giving them edge over competition. This is not only restricted to money but also to physical assets such as real estate which can be transferred between two parties almost instantly without the need of long and time

consuming paper work and verification. Companies can also enhance the speed of certain actions to be performed as soon as certain conditions are met through smart contract.

Respondent 6

International transfer on average take about 10 minutes in the case of bitcoin where it's forked siblings such as bitcoin cash and other cryptocurrencies such as Ether and Dash take even less time. A normal international remittance will take at least 4 days to a week to transmit not mentioning the heavy fees incurred in doing so.

Respondent 7

International money remittance is a classic example where banks with all the infrastructure and global presence still takes days to process an across the border remittance and charging a hefty fee to do so. On the other hand, blockchain platforms can process an international remittance within minutes and in some cases seconds charging a minor fee. Blockchain would not only affect services such as international money transfer but all such services which require security and possibly a quicker lead time to process.

Respondent 8

We are yet to see common use cases where blockchain would empowers it's user to conduct business with speed. Provision of public services is one area which has traditionally been slow and bureaucratic. Factom is an example of a blockchain platform working with the Chinese government to bring such services to their citizens.

Quality

Respondent 1

In many scenarios the need for reconciliation becomes redundant as there is a common source of truth and an atomic execution of logic, this does lead to greater process automation, but not necessarily 'quality' as upstream systems may still provide bad data.

Respondent 2

no impact

Respondent 3

If the input of the transaction is incorrect the potential quality error can not be corrected via blockchain

Respondent 4

Combining blockchain based identity, AI and structured data will enable automation disruption of the kind that we have not seen before.

Respondent 5

Services that offer peer to peer exchange or smart contracts via blockchain will be able to not only automate their internal work processes but also external interactions with customers reducing human errors, which will eventually enhance the quality of their services.

Respondent 6

If input is not correct, blockchain platform can not rectify it.

Respondent 7

Smart contracts are a perfect example of process automation where the terms and conditions and rules of a contract are spelled in the form of a programming code. They remove the need for manual intervention or human discretion. Businesses engaging smart contracts will be quicker in processing customer requests and business contracts will execute automatically.

Blockchain provides a mechanism for businesses to streamline and automate processes however it cannot verify the authenticity of the original data source. This is especially the case with businesses that will move from a traditional system to a blockchain and so if the original source of data has errors it will be migrated to the blockchain.

Respondent 8

Since there will be only one system instead of multiple systems integrated with each other, it will result in greater automation since the element of human intervention and discretion will be removed.

Productivity

Respondent 1

no impact

Respondent 2

Productivity may be increased in a system based on some of the properties above (namely speed, efficiency, and transparency) but I don't think blockchain has an impact on productivity directly.

Respondent 3

If the speed (leadtime) increases as assumed, more work can be done with the additional free capacity and thus the positive impact on productivity can be remarkable

Respondent 4

Productivity will be an outcome of realizing the benefits previously listed.

Respondent 5

By allowing interoperability and automation companies can become more productive as the turn around time for decisions, actions, tasks and processes reduces.

Respondent 6

No idea

Respondent 7

No impact

Respondent 8

Blockchain can make firms more productive only by freeing up time for employees through its other attributes

Cost Savings

Respondent 1

no impact

Respondent 2

Blockchain networks cost way more to start up than their traditional counterparts. In almost all cases, developing a decentralized network to save money doesn't make sense. Using an existing decentralized network, however, could make sense: see Storj/FileCoin, Golem, etc that minimize costs for resources by providing them through a decentralized marketplace.

Respondent 3

Automation of the key processes enabled by blockchain can help companies to realize cost savings.

Respondent 4

There will be some cost savings, but I don't see that there will be huge ones.

Respondent 5

Cost of maintaining digital structures such as servers, databases, firewalls etc can be saved by using blockchain , particularly in cases where cloud services are not an option for companies due to sensitivity of data. Cost associated to third party verification and processing services can be significantly reduced as companies can do away with services such as escrow, swift or visa. Also customers can benefit from speedy services which may attract them to companies using blockchain, thus increasing revenues. Further, companies can use tokens as a new form of payment stream for their services, price of which is based on demand and supply conditions of the market. This allows for a more market based pricing model rather than companies having to determine pricing structures. Also, customers may view it as a more fair means of pricing.

Respondent 6

Can not impact directly but through various ways indirectly

Respondent 7

It maybe cost effective for business to develop blockchain platforms in the long run but I can not say for sure at this time

Respondent 8

Small and medium businesses are better off using existing blockchain platforms that will provide them with capacity and decentralisation of their data at a much reduced cost. It would be smarter to not to reinvent the wheel when platforms have been developed for this purpose.

Appendix C-1

Questionnaire Round 2

Thank you for taking your time to participate in the second round of this study. Rest assured, all answers you provide will be kept confidential. This questionnaire is part of round two of the study and it has been created from the responses gathered through Round one questionnaire. The purpose of this round is to find common agreement among respondents over the statements provided below in the questionnaire.

On a scale of 1-10 how much do you agree with the following statements

Statements
Privacy   Removal of intermediaries through decentralization increases customer's privacy.   Decentralization will affect businesses that utilize customer data for revenues.

Transparency

Transparency is one of the biggest advantages a business can get by operating within a public blockchain network.

Blockchain can help develop more trustworthy ecosystems.

Efficiency

Blockchain platforms can allow leaner data sharing infrastructure.

Blockchain networks enable coordination and consensus to be achieved at scale.

Lower fraud risk

Decentralized database costs way more to break into as compared to centralized database.

Decentralized systems reduce the risk of data fraud and tampering.

Security

A well designed decentralized protocol is more resilient to cyber attacks.

Blockchain may help reduce reliance on cyber security firms?

Equitable Access

Blockchain platforms will allow inclusion of the unbanked into the financial ecosystem.

Blockchain platforms are based on the premise of inclusivity not exclusivity

Speed

Blockchain platforms can increase the speed of value transfer over the internet.

Blockchain platforms will reduce the need for time consuming paperwork required to transfer physical assets.

Quality

Blockchain platforms can lead to greater process automation.

Blockchain platforms can rectify data input errors

Productivity

Blockchain platforms can directly increase productivity of businesses.

Blockchain platforms can indirectly increase productivity of businesses.

Cost Savings

Developing an internal decentralized infrastructure is less costly for businesses.

Blockchain enables cost savings by removing intermediaries

Appendix C-2

Round Two Results

Statements	Respondent #								Mean	IQR
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**		
Removal of intermediaries through decentralization increases customer's privacy.	6	8	9	9	9	10	10	10	8.9	1.5
Decentralization will affect businesses that utilize customer data for revenues.	4	5	6	7	8	8	9	9	7.0	3
Transparency is one of the biggest advantages a business can get by operating within a public blockchain network	5	6	7	7	7	8	8	10	7.3	1.5
Blockchain can help develop more trustworthy ecosystems.	8	8	8	9	10	10	10	10	9.1	2
Blockchain platforms can allow leaner data sharing infrastructure	3	4	5	6	7	7	8	9	6.1	3
Blockchain networks enable coordination and consensus to be achieved at scale.	5	6	7	7	8	9	9	10	7.6	2.5
Decentralized database costs way more to break into as compared to centralized database	2	4	4	5	6	8	8	10	5.9	4
Decentralized systems reduce the risk of data fraud and tampering.	3	4	6	6	7	8	9	10	6.6	3.5
A well designed decentralized protocol is more resilient to cyber attacks	4	6	6	7	8	8	9	10	7.3	2.5
Blockchain may help reduce reliance on cyber security firms	1	2	2	3	3	4	4	7	3.3	2
Blockchain platforms will allow inclusion of the unbanked into the financial ecosystem	7	7	8	8	8	9	10	10	8.4	2
Blockchain platforms are based on the premise of inclusivity not exclusivity.	6	7	7	8	8	8	9	10	7.9	1.5
Blockchain platforms can increase the speed of value transfer over the internet.	3	8	8	9	10	10	10	10	8.5	2
Blockchain platforms will reduce the need for time consuming paperwork required to transfer physical assets.	4	7	7	8	8	9	9	10	7.8	2
Blockchain platforms can lead to greater process automation.	5	5	6	7	9	9	9	10	7.5	3.5
Blockchain platforms can rectify data input errors	1	1	1	2	2	3	3	5	2.3	2
Blockchain platforms can directly increase productivity of businesses.	1	1	1	2	2	2	5	5	2.4	2.5

Blockchain platforms can indirectly increase productivity of businesses.	8	8	8	8	8	9	10	10	8.6	1.5
Developing an internal decentralized infrastructure is less costly for businesses.	1	1	1	1	2	2	2	4	1.8	1
Blockchain enables cost savings by removing intermediaries	5	6	6	6	7	8	9	9	7.0	2.5

Appendix D-1

Round Three Questionnaire

Dear Respondent,

Thank you for taking your time to participate in the third and final round of this study. Rest assured, all answers you provide will be kept confidential.

This questionnaire is part of round tree of the study and gives you the chance to reconsider your responses for statements where the recorded range of responses provided by the panel of experts varied. The purpose of this round is to find common agreement among experts over the statements provided below in the questionnaire. To provide you with some context, the mean score of all respondents is given along with your score in the previous round below each question.

Statement
Privacy   Decentralization will affect businesses that utilize customer data for revenues.   **Efficiency**   Blockchain platforms can allow leaner data sharing infrastructure.   Blockchain networks enable coordination and consensus to be achieved at scale.

Lower fraud risk

Decentralized database costs way more to break into as compared to centralized database.

Decentralized systems reduce the risk of data fraud and tampering.

Security

A well designed decentralized protocol is more resilient to cyber attacks.

Quality

Blockchain platforms can lead to greater process automation.

Productivity

Blockchain platforms can directly increase productivity of businesses.

Cost Savings

Blockchain enables cost savings by removing intermediaries.

Appendix D-2

Round Three Results

Statements	Respondent #								Mean	IQR
	1	2	3	4	5	6	7	8		
Decentralization will affect businesses that utilize customer data for revenues.	4	5	6	7	8	8	9	9	7.0	3
Blockchain platforms can allow leaner data sharing infrastructure.	3	4	5	6	7	7	8	9	6.1	3
Blockchain networks enable coordination and consensus to be achieved at scale.	5	6	7	7	8	9	9	10	7.6	2.5
Decentralized database costs way more to break into as compared to centralized database.	2	4	4	5	6	8	8	10	5.9	4
Decentralized systems reduce the risk of data fraud and tampering.	3	4	6	6	7	8	9	10	6.6	3.5
A well designed decentralized protocol is more resilient to cyber attacks.	4	6	6	7	8	8	9	10	7.3	2.5
Blockchain platforms can lead to greater process automation.	5	5	6	7	9	9	9	10	7.5	3.5
Blockchain platforms can directly increase productivity of businesses.	1	1	1	2	2	2	5	5	2.4	2.5
Blockchain enables cost savings by removing intermediaries.	5	6	6	6	7	8	9	9	7.0	2.5